

Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region

1993 Annual Report



August 1994

Western Pacific Regional Fishery Management Council
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for the

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Bottomfish and Seamount Groundfish Fisheries of the Western Pacific

1993 Annual Report

1.0 INTRODUCTION

The 1993 annual report provides a set of descriptors and indicators of the bottomfish fisheries from American Samoa, Guam, Hawaii and the Northern Mariana Islands. The descriptors are designed to document recent trends in landings, effort, participation, revenue and prices. Should management action be recommended, descriptor information will aid in assessing potential impacts of the action on fishery participants. The indicators are quantifiable and measurable tools used to identify signs of stress in the stocks or the fishery. Based on changes over time in indicator levels, the Bottomfish Plan Team (BPT) may identify "yellow light" situations (i.e., where stress is first detected) and recommend that either management action or additional study be undertaken.

This year's report is organized as follows: The introduction section defines and briefly explains the descriptors and indicators. The next section briefly summarizes time trends in descriptor and indicator levels, through the current year, and recommends any areas of concern for each island area. Reports from each island area are appended. The introduction describes the history and present characteristics of the fishery. Results of the year's descriptors and indicators are presented in detail, in relation to past temporal trends. Figures are supported with information on source of the data, methods of calculation, and data interpretation. Table 1 summarizes 1993 bottomfish statistics for the region. The appended report from each area concludes with a summary, which addresses progress made on the previous year's recommendations, and new recommendations. Finally, additional appendices contain information on NMFS 1993 administrative and enforcement activities, habitat conditions, protected species interactions, and 1993 BPT membership.

Table 2 lists scientific, common English and local/indigenous names for bottomfish management unit species for each area (American Samoa, Guam/Northern Marianas, Hawaii).

1.1 Definition of Descriptors

The fishery descriptors are defined as follows:

1.1.1 Landings information

Time series information on aggregate catch for each island area shows recent trends in total bottomfish harvest. For American Samoa and Guam, estimates of both the commercial landings and the total landings (combined commercial, recreational and subsistence) are available. For Hawaii and the Northern Marianas, landings information represents only the commercial harvest.

Table 1. Regional Summary of 1993 Bottomfish Statistics

	HI						
	AS	GU	MP	All	MHI	Mau	Hoomalu
BMUS Landings (lb) ¹	14,534	48,494	14,769	733,000	348,000	98,000	287,000
Revenue (\$) ¹	28,984	29,348	37,310	2,312,000	--	--	--
Number of Boats	23	271	20	--	--	8	4
Number of Trips	95	6,265	178	--	--	72	34
CPUE	12.3 lb/h	4.8 lb/h	83 lb/trip	--	202 lb/day	254 lb/day	743 lb/day
SPR	0.41	--	--	--	*2	*3	* 3

1) Regional totals (all areas): Landings = 810,797 lb; Revenue = \$2,407,642

2) Species with Spawning Potential Ratio near or below critical level of 0.20 (recruitment overfished): onaga (SPR = 0.13); opakapaka (SPR = 0.21)

3) Healthy (SPR > 0.20) for all species

Table 2. Bottomfish Management Unit Species (BMUS) Names

(Absence of an indigenous name implies no local name established or area is not within the species' geographic range.)

Scientific	English Common	American Samoa	Guam/CNMI	Hawaii
<u>Bottomfish:</u>				
355 L <i>Aphareus rutilans</i>	red snapper/silvermouth	palu-gutusiiva	marap tatoong	lehi
L <i>Aprion virescens</i>	gray snapper/jobfish	asoama	tosan	uku
313 C <i>Caranx ignobilis</i>	giant trevally/jack	sapoanae	tarakito	white ulua/pau'u
C <i>C. lugubris</i>	black trevally/jack	tafaui	trankiton attilong	black ulua
335 S <i>Epinephelus fasciatus</i>	blacktip grouper	fausi	gadao matai	
<i>E. quernus</i>	sea bass			hapu'upuu
<i>Etelis carbunculus</i>	red snapper	palu-malau	guihan boninas	ehu
<i>E. coruscans</i>	red snapper	palu-foa	onaga	onaga
362 <i>Lethrinus amboinensis</i>	ambon emperor	filoa-gutumumu	mafuti/lililok	
<i>L. rubrioperculatus</i>	redgill emperor	filoa-pa'o'omumu	mafuti tatdong	
<i>Lufjanus kasmira</i>	blue-line snapper	savane	sas/funai	ta'ape
<i>Pristipomoides auricilla</i>	yellowtail snapper	palu-i'usama	guihan boninas	yellowtail kalekale
<i>P. filamentosus</i>	pink snapper	palu-'ena'ena	guihan boninas	opakapaka
<i>P. flavipinnis</i>	yelloweye snapper	palu-sina	guihan boninas	yelloweye opakapaka
<i>P. seiboldi</i>	pink snapper		guihan boninas	kalekale
<i>P. zonatus</i>	snapper	palu-sega	guihan boninas/gindai	gindai
<i>Pseudocaranx dentex</i>	thicklip trevally		terakito	butaguchi/pig ulua
<i>Seriola dumerili</i>	amberjack		guihan tatdong	kahala
<i>Variola louti</i>	lunartail grouper	papa	bueli	

Seamount Groundfish:

<i>Beryx splendens</i>	alfonsin	kinmedai (Japanese)
<i>Hyperoglyphe japonica</i>	ratfish/butterfish	medai (Jap.)
<i>Pseudopentaceros richardsoni</i>	armorhead	kusakari tsubodai (Jap.)

In Hawaii, changes in species catch composition are provided for the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI). Statistical tests for consistency in catch composition over time and between areas are included. Where possible, descriptor information has been presented for each NWHI management zone: Hoomalu and Mau. For 1993, pounds landed by species are presented in tabular form for each area except Hawaii. For Hawaii, NWHI bottomfish management unit species (BMUS) landings by species are provided for 1986 through 1993.

1.1.2 Effort information

Effort is measured in number of trips for Hawaii and the Northern Marianas, and in both hours fished and trips taken for American Samoa and Guam.

1.1.3 Participation information

Estimates of the number of vessels making bottomfish landings are provided for all areas.

1.1.4 Economic information

Time trends in economic performance are characterized by plots of total ex-vessel revenue, aggregate average price levels, and for Hawaii, price trends over time for major species. In time-series of prices and revenues, it is appropriate to adjust value for the rate of inflation so that values throughout the time period are comparable (based on a consistent purchasing power for the dollar). Both the unadjusted and adjusted aggregate average price and aggregate revenues are plotted to clarify the relative change over time.

1.2 Definition of Indicators

Indicators were developed as tools for identifying signs of stress in the stocks or the fishery which deserve further investigation and/or a management response. Analyses consider how the indicators change over time. In this year's report, for the first time, indicators from Hawaii include 95% confidence intervals. To the degree possible, similar variance estimates are expected from the other areas in future annual reports. The indicators are defined as follows:

1.2.1 Aggregate Catch-Per-Unit-Effort

If the current year's aggregate catch-per-unit-effort (CPUE) is less than 50% of the average aggregate CPUE for the first three years of available data, there may be cause for concern. CPUE information is available for all areas; research CPUE is available for SE Hancock Seamount for all years since 1985, except 1992.

1.2.2 Mean Fish Size

If there has been a significant reduction in mean fish size for a species over time, the stock may be stressed by the fishery. Mean size information is provided for seven species in

Hawaii. No mean size information was available at this time for American Samoa, Guam or the Northern Marianas.

1.2.3 Percent Immature

If over 50% of the catch for a species is below the size of first maturity, the stock may be stressed by the fishery. Information for this indicator is available only from Hawaii.

1.2.4 Spawning Potential Ratio

The spawning potential ratio (SPR) is the ratio of the spawning stock biomass per recruit, at the current level of fishing, to the spawning stock biomass per recruit that would occur in the absence of fishing. According to the overfishing definition contained in the Bottomfish FMP (Amendment 3, 1990), if SPR is less than or equal to 0.20, recruitment overfishing has occurred (i.e., spawners have been reduced to 20%, or less, of their unexploited stock level). Data to calculate SPR were not available from Guam or the Northern Marianas. An estimate of the "worst case" SPR was calculated for American Samoa's bottomfish complex using Dory Project data to estimate the virgin population CPUE and information on percent of immature fish from Hawaii. In Hawaii, SPR was calculated for six major species in the Hoomalu and Mau Zones, of the NWHI, and the MHI; all SPR values changed slightly from previous year's reports due to improvement in the calculations. SPR for armorhead was calculated annually since 1985, except for 1992.

1.2.5 Economic Indicators

Revenue per trip plots are presented for all areas except the MHI. A more valuable indicator for the commercial fisheries, which may be available in the future, would be net revenue (ex-vessel revenue minus costs per trip).

2.0 AREA SUMMARIES

2.1 American Samoa

2.1.1 Descriptors

Bottomfish landings declined from 1988 to 1992. This trend may be attributed to the following: the three hurricanes that struck the territory (in 1987, 1990 and 1991), the departure of several highliners from the fishery, the shift in importance from bottomfishing to trolling, and the substitution of imported fish from Western Samoa and Tonga. The 1993 total landings increased 19% compared to the previous year.

Fishing effort, measured by the number of trips, again declined in 1993 (14% less trips than in 1992), reflecting a continued decline in profit and interest in bottomfishing. Total hours of fishing effort in 1993 were about the same as in 1992. The increase in

number of vessels in the fleet in 1993 was primarily due to the re-entry to the fishery of boats following repairs, due to past hurricanes.

Actual prices were relatively stable from 1986-1990, then increased in 1991 and 1992, followed by a decline in 1993 to 1991 levels. Inflation adjusted prices fluctuated from 1986 to present with 1993 prices below 1992 and 1991 levels.

2.1.2 Indicators

CPUE (pounds per hour), which was relatively stable (at about 10 lb/hr) the previous three years, increased 17% in 1993, indicating a healthy fishery. The proxy "worst case" SPR was 0.41 in 1993, indicating that recruitment overfishing has not occurred. Size and maturity data were collected from key species, but insufficient sample sizes were available for SPR estimation. The drop in revenue per bottomfish trip reflects the decline in trips in 1993, and could contribute to the declining interest in bottomfishing.

2.1.3 Recommendations

1) Available data do not indicate any problems with the bottomfish fishery or stocks in American Samoa. The plan team recommends that the program to collect length and maturity data be continued. This information should permit SPRs to be estimated more reliably, with data exclusively from American Samoa.

2.2 Guam

2.2.1 Descriptors

The fairly large fluctuations over time in bottomfish landings in Guam appear to be due more to entry and exit patterns of fishermen, rather than changes in fish stocks. The total bottomfish landings increased 56% in 1993, as the number of boats increased 57%, compared to 1992.

In 1993, the number of trips increased nearly three-fold and total hours of fishing effort nearly doubled, from 1992 levels, due to good weather and the substantial increase in participants.

The adjusted average price for bottomfish has not shown consistent marketing trends. This is expected to have resulted from the seasonal supply of pelagic fish and difficulties in developing a consistent market for locally caught fish. In addition, imported fish from other islands around the region have contributed to the continued marketing problem for local fishermen.

2.2.2 Indicators

The CPUE has fluctuated between 5-8 lb/hr, but has been fairly stable for the past eight years. The slight decrease in 1993 may be due to a reduction in CPUE of the shallow-

water species complex targeted by inexperienced fishermen. Overall, no problem is indicated by CPUE.

The adjusted average revenue per trip does not appear to show any long-term trend. The slight decrease in revenue during the past few years may be due to the increase in imported bottomfish.

2.2.3 Recommendations

1) The 1992 and 1993 data are not representative of the data analysis required for the bottomfish annual report. This resulted from the loss of the data processing specialist. This deficiency continues to jeopardize both the integrity of the data and the funding of these programs. The BPT recommends that this problem be rectified as soon as possible and that the 1992 and 1993 data be analyzed sufficiently with the computerized expansion.

2) The need to complete a baseline biological survey for the red-gilled emperor still remains the major need for the Marianas shallow-water bottomfish resource. The BPT, therefore, again recommends that a joint program with the CNMI be established as a high priority.

3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deepwater bottomfish complex (e.g., survey on red-gilled emperor) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), to help calculate SPR, with assistance from NMFS.

2.3 Hawaii

2.3.1 Descriptors

Main Hawaiian Islands: Only commercial data are available for both the MHI and NWHI fisheries, even though in the MHI recreational/subsistence catch is estimated to be about equal the of commercial landings. In 1988, there was a dramatic increase in MHI bottomfish landings due to a bonanza uku (gray snapper) harvest. Since that time there has been a steady decline in total landings, which stabilized from 1990-1992. Landings in 1993 are the lowest recorded and for the first time dropped below those of the NWHI. Effort by number of trips continued to decline from the 1988 peak. This may be due to increased interest in pelagic fisheries.

Total ex-vessel revenue from the MHI has also continued a general decline since 1988, mainly due to decreased landings. Overall bottomfish landings and market dollar volume (adjusted for inflation) have continued this decline in 1993, but inflation-adjusted average price appears to be relatively stable in recent years.

NWHI Mau Zone: Mau Zone 1993 landings have increased 38% over 1992. The total number of boats remained the same (at eight), while the number of trips increased by 31%. In addition, bottomfish landings per trip increased by 4%.

NWHI Hoomalu Zone: Hoomalu Zone 1993 landings have decreased 19% from 1992. Four total boats fished in the zone (one less than last year), while the number of trips decreased by 8%. In addition, bottomfish landings per trip decreased by 11%.

Available revenue data are not separated by zone. Total NWHI revenue was relatively stable from 1990 to 1992, but dropped slightly in 1993. Inflation-adjusted average bottomfish prices have increased slightly over the past two years.

2.3.2 Indicators

MHI: Following the increased in CPUE from 1991 to 1992, CPUE dropped back to its 1991 level in 1993. Recent CPUE values are about a third of early (baseline) values, signifying a yellow-light condition in the MHI. The increase in the late 1980's MHI CPUE was primarily due to a large increase in uku catches, and may not indicate an increase in abundance in other species. Most of the more commercially important species in the MHI have had relatively stable mean weights. Hapuupuu exhibited the most notable decrease in mean weight (and increase in percent of immature catch) in 1993, but sample size was small (only 2.5% of the catch). MHI onaga again had the highest percentage of immature fish, and was the only species where over 50% of the catch was consistently immature, signifying a yellow light condition.

All SPR values changed slightly from the previous year's reports due to improvements in the calculations. This year, for the first time, 95% confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature). Of the six major species for which the SPR indicator was calculated, only onaga was below the 0.20 "critical" level, indicative of recruitment overfishing, while opakapaka approached this level (SPR = 0.21). Onaga SPR has now been below 0.20 for the past five years. During the first three years of estimates (1986-1988), onaga had a mean SPR of 0.24; during the last three years (1991-1993) its mean SPR was 0.11. SPR values for MHI ehū, hapuupuu, and uku have consistently remained the highest.

NWHI Mau Zone: The NMFS CPUE data are only available for the NWHI fishery as a whole since 1984 and by zone since 1988. The NWHI (combined Mau and Hoomalu Zones) NMFS CPUE steadily decreased from 1987 to 1992, then rose to 523 lb/day in 1993, which is 71% of the average of the first 3 years (739 lb/day, 1984-86). The Mau Zone NMFS CPUE has been steadily decreasing since 1989, but rose slightly in 1993. The Mau Zone HDAR CPUE decreased 63% from 1989 to 1993, with the 1993 value only 34% of the average of the first three years (5,911 lb/trip, 1948-50). Non-parametric 95% confidence intervals were calculated for HDAR CPUEs by the "bootstrapping" method. Mean weights of fish in the Mau Zone continue to exhibit year to year fluctuations, but are still at much higher values than MHI mean weights. The percent of immature fish in the 1993 catch was still safely under 50% for all species evaluated.

The SPR values in the Mau Zone have been decreasing since 1990, mirroring the pattern in the HDAR CPUE. All values are presently above 0.35. Mau Zone SPR estimates tend to be lower than Hoomalu zone estimates.

NWHI Hoomalu Zone: The Hoomalu Zone NMFS CPUE has been decreasing since 1988, but in 1993 increased 13% over the previous year's level. The Hoomalu Zone HDAR CPUE has increasing slowly since 1989, with the 1993 value 9% higher than the 1992 value and 95% that of the average of the first three years (8,440 lb/trip, 1948-50). Mean weights of fish in the Hoomalu Zone continued to exhibit year to year fluctuations, but are still at much higher values than MHI mean weights. The percent of immature fish in the 1993 catch was still safely under 50% for all species evaluated.

The SPR values in the Hoomalu Zone slowly increased since 1989, mirroring the pattern in the HDAR CPUE. All 1993 values are near or above 1.00.

Seamount Groundfish (Armorhead): No fishing has been allowed on the armorhead stocks of the SE Hancock Seamount since the moratorium began in August, 1986. In 1993, CPUE, calculated from research longline catches, was more than double that of the last assessment (in 1991) and nearly as high as the highest CPUE recorded since surveying began in 1985. There was no research assessment cruise in 1992.

SPR within the EEZ (SE Hancock Seamount) was above 0.02, the highest since 1986, but still far below the threshold level for recruitment overfishing of 0.20. About 99% of the known armorhead seamount habitat occurs outside the EEZ. These high-seas stocks experienced a short pulse in recruitment in 1992, which sustained high catches, but did not carry over into 1993.

2.3.3 Recommendations

1) In light of the Council's decision for the State of Hawaii to take lead responsibility for managing bottomfish, the BPT understands its responsibility to be monitoring and reporting of the status of the fishery in the MHI and identifying where problems occur, but no longer to identify and evaluate various management options.

2) Again, remind the State of the continuing serious condition of MHI onaga (now recruitment overfished for the past 5 years), and encourage it to correct the situation through soonest possible action. Also, inform the State that opakapaka is now on the borderline of being overfished (SPR = 0.21) and ehu is in a yellow-light condition with CPUE reaching less than one-tenth its original level.

3) The BPT expresses severe reservations regarding the effectiveness of the new catch reporting system (old C-3 form together with the State's new Trip-Sales Report) being implemented for the NWHI fishery. Of most concern is critical information that will be missing on interactions with protected species, loss to predation and line-hours of effort fished, in addition to the increased difficulty for fishermen to fill out these forms. The BPT requests that NMFS provide a complete report on the progress and effectiveness of this new catch reporting system by 1 March 1995, with adequate detail on data providing catch per

day vs. catch per trip, total number of trips captured by the data form, comparison of pounds caught (from catch reports) vs. catch monitoring (by NMFS).

4) Proceed with the minor regulatory changes recommended by NMFS-Office of Enforcement to: 1) Modify 50 CFR 683.21(b) to explicitly prohibit bottomfish fishing in the Mau Zone without a permit; 2) Modify 50 CFR 683.6(e) to explicitly require NWHI bottomfish vessels to visibly display their official number (similar to other fisheries); 3) Require fish dealers to make all records involving catch from permitted vessels available for federal inspection; and 4) Attempt to clarify any other regulations so more easily understood.

5) Again, strongly encourage the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

6) Again, strongly encourage NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction (reduced from 6 to 2 days per week) and expand this sampling to major dealers on all other main Hawaiian Islands.

2.4 Northern Mariana Islands

2.4.1 Descriptors

Data are available only on the commercial fishery. The declining trend in landings and revenues (1988-91), which reversed in 1992, increased further in 1993. This is due to growth of the local bottomfishing industry. Also, an increasing number of boats are fishing the islands north of Saipan, where bottomfish are more abundant.

The average price received for bottomfish dropped slightly to \$2.53 (from \$2.58 in 1992), due to the majority of bottomfish being sold at wholesale price by a dominant vendor. Total ex-vessel revenue increased in 1993.

2.4.2 Indicators

The average bottomfish catch per trip increased by 41% in 1993 compared to 1992. The average catch per trip is subject to significant biases (e.g., changes in trip length and relative amounts of bottomfishing compared to trolling). It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish species exclusively. While such a calculation may be sensitive to other biases due to small sample size, it should be investigated in the future. This indicator does not suggest the need for any management action.

Even though bottomfish effort and landings are increasing, the revenue obtained from bottomfish sales are relatively stable in its importance. This may be a function of the bottomfish fisherman trolling to and from the bottomfishing site, thus having a mixed catch after spending the day "bottomfishing".

2.4.3 Recommendations

1) A bottomfishing training/workshop is recommended that focuses on improving gear, fishing techniques and local markets and stabilizing supplies.

2) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deepwater bottomfish complex (e.g., survey on red-gilled emperor) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), to help calculate SPR, with assistance from NMFS.

2.5 Region-Wide Recommendations

The BPT recommends the following improvements for the annual report:

1) Include some form of variance estimate for stock indicator parameters.

2) Include a list of scientific, common and local indigenous names from each area.

3) Develop separate MSY estimates for the shallow-water species complex (i.e., based on habitat area for AS, GU and MP), including data on virgin population catch rates, percent immature, and SPR.

Appendix 1

American Samoa

Introduction

Subsistence bottomfishing from canoes had been employed in the distant past by the people of American Samoa. But it was not until the early 1970s that the bottomfish fishery developed into a commercial venture utilizing motorized boats. A government subsidized program, called the Dory¹ Project, was initiated in 1972 to develop the offshore fisheries into a commercial venture, resulting in an abrupt increase in the fishing fleet and total landings. In 1982 a fisheries development project aimed at exporting high-priced deep water snappers to the Hawaii auction² caused another notable increase in both bottomfish landings and revenue. Between 1982 and 1988, the bottomfish fishery comprised as much as 50% of the total commercial catch. Since 1988 the nature of the fishery has changed dramatically with a shift in importance towards trolling as revealed by a 63% decrease in bottomfish landings between 1988 and 1990. This was a result of the decrease in the number of full-time commercial fishermen who had formerly preferred the more profitable bottomfish method.

The adverse effects of three hurricanes that struck American Samoa in 1987, 1990 and 1991 can be seen in some of the trends in the fishery as depicted by the data in this report.

Since the onset of DMWR's offshore data collection efforts in the early 1970s, fisheries monitoring was conducted on Tutuila through an interviewing program of only commercial fishers. With the assistance of the Western Pacific Fisheries Information Network (WPacFIN), a new sampling program that sampled both commercial and recreational boats, was implemented in October 1985. The present report is based on the data from this new sampling program. In this creel survey, boats landing catches in five designated areas were interviewed and their catches examined. For two weekdays and one week-end per week, DMWR data collectors sampled offshore fishers between 0500 and 2100 hours. Two DMWR samplers based on the Manu'a islands collect fisheries data from the Tau, Ofu and Olosega fleet.

The bottomfish fisheries of American Samoa are typically one-day fisheries utilizing 28-foot aluminum catamarans (Alia). During 1993, an estimated total of 23 domestic boats landed nearly 17,000 pounds of bottomfish in the territory. Inflation-adjusted revenue for the domestic commercial fishery this year was estimated around \$29,000 with virtually all the catch being sold locally. Boat-based fishing was mostly trolling and bottomfishing.

¹ dory = 24-foot gasoline/diesel inboards

² United Fishing Agency (UFA) auction in Honolulu

Summary

The fishery was relatively bigger between 1982 and 1986 than in recent years (Fig. 1). This observation reflects a trend in the loss of skilled and full-time fishermen from the fishery. Another important trend mirrored by the data is the shift of preference from bottomfishing to trolling, as the number of full-time commercial fishermen who could stay bottomfishing overnight decreased. The December 1991 hurricane contributed to the 1992 decrease in landings (Fig. 1) and the second lowest number of trips ever recorded (Fig. 3). The availability of cheaper imported bottomfish from Western Samoa and Tonga has assisted in satisfying the high demand for fresh fish that cannot be met by local fishermen. An increase (19%) in total landings observed this year masked the declining importance of this fishery as indicated by the lowest number of trips ever documented.

Available data do not indicate any significant problems with the bottomfish fishery or the stocks. The CPUE (pounds per hour) in 1993 was 83% of the baseline CPUE, indicating no severe signs of stress in this fishery. The "estimate of the worst case" SPR (refer to the analysis in Fig. 7) indicated that recruitment overfishing is not occurring in this fishery.

DMWR continued to collect size at maturity and length frequency data from key species, as recommended in last year's bottomfish annual report. Samples of *Lutjanus kasmira* and assorted emperors (*Lethrinus* sp.) were bought from local fishermen at landing sites for this project. More samples are still needed to provide sufficient data for the proper estimation of SPR.

The previous concern for the continuous decline in CPUE, mentioned in the 1991 bottomfish annual report, subsided as the 1992 and 1993 summaries depicted increases in both CPUE and SPR.

Recommendations

- 1) To provide adequate coverage of the fisheries, collect necessary biological samples for FMP monitoring purposes and subsequently produce better estimates of the fisheries, DMWR should hire an additional data collector.
- 2) The program for collection of length/weight and maturity data should be continued to obtain adequate samples for estimating SPR, using data obtained exclusively from American Samoa. This program has been implemented by DMWR in the past two years, as recommended by the Bottomfish Plan Team.

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Table 1. American Samoa 1993 Estimated Total Bottomfish Landings

Species	Pounds
Redgill Emperor	229
Ambon Emperor	935
Longnose Emperor	119
Emperors (misc)	2220
Tomato Grouper	294
Giant Grouper	276
Flagtail Grouper	7
Yellowspotted Grouper*	104
Peacock Grouper	165
Lyretail Grouper	744
Grouper (misc)	641
Oilfish	202
Bluelined Snapper	2015
Gindai	229
Jobfish	2269
Onaga	1518
Ehu	1111
Humpback Snapper	910
Red Snapper	145
Yelloweye Opakapaka	116
Pink Opakapaka	526
Etelis sp.	94
Yellowtail Kalekale	68
Lehi	443
Bluelined Gindai	28
Black Trevally	339
Jacks (misc)	564
Bottomfish (misc)	473
Total Bottomfish	16785
Total BMUS	14534

* *Epinephelus* sp.

Calculation: Catches are weighed by species either at landing sites or during the selling of fish to dealers. Because of the variability among years of the proportion of sampled bottomfish catch that was identified to species, and because the bottomfish complex contains many more species (some important) than specified in the FMP, analyses of American Samoa's bottomfish data are for the whole complex, not just for BMUS.

Interpretation: There have been changes in the recorded species composition of the bottomfish complex landed in the past years. The appearance of two species (*Paraceasios* *stonei* and *Lethrinus* *kallopterus*) last year and ten new species this year. These species were occasionally present in landings from previous years, but were not identified to the species level. Furthermore, DMWR data collectors have improved the identification of various local species in the bottomfish complex.

Table 2. American Samoa 1993 Estimated Average Price of Bottomfish Species

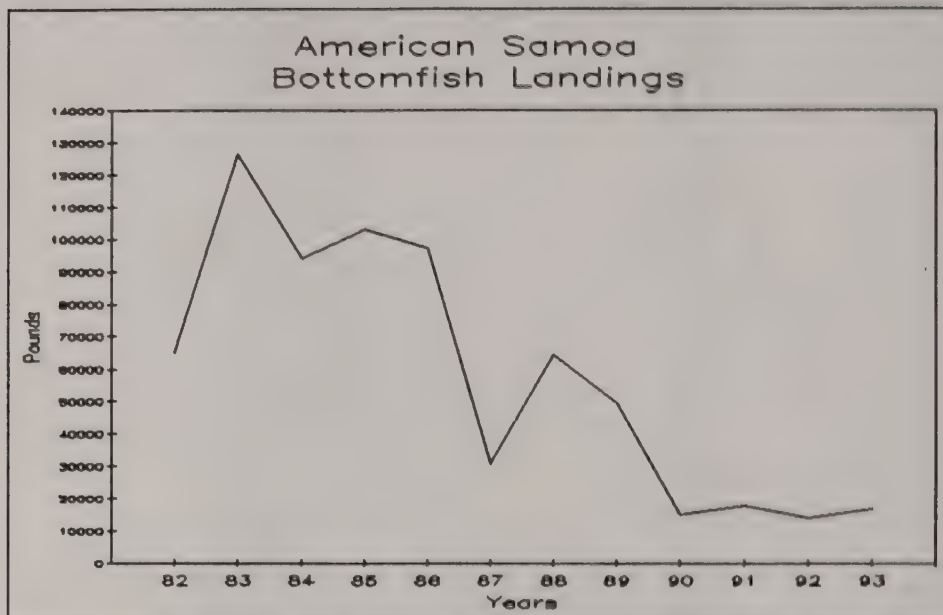
Species	Ave. Price (\$/lb)
Redgill Emperor	1.90
Ambon Emperor	1.78
Longnose Emperor	2.75
Emperors (misc)	1.71
Tomato Grouper	1.74
Giant Grouper	2.00
Flagtail Grouper	1.65
Yellowspotted Grouper*	2.50
Peacock Grouper	1.90
Lyretail Grouper	1.67
Grouper (misc)	1.67
Oilfish	2.50
Bluelined Snapper	1.77
Gindai	1.78
Jobfish	1.73
Onaga	1.75
Ehu	2.27
Humpback Snapper	1.72
Red Snapper	1.90
Yelloweye Opakapaka	1.63
Pink Opakapaka	1.65
Etelis sp.	1.25
Yellowtail Kalekale	2.50
Lehi	2.90
Bluelined Gindai	2.50
Black Trevally	1.95
Jacks (misc)	1.47
Bottomfish (misc)	1.65
Total Bottomfish	1.81
Total BMUS	1.80

Calculation: During creel surveys, the disposition of the catch is recorded, and if sold, the price is obtained whenever possible. The average prices reported in this table are calculated by dividing the total revenue by the sold weight in pounds for each species.

Interpretation: Average prices of locally caught bottomfish species have been rising since 1989 and there appears to be no significant changes in the prices of individual species in the past three years. In 1992 and again this year, the average price of bottomfish imported from Western Samoa (\$1.64/lb) was lower than of those caught locally. This can be due to the fresh quality of bottomfish caught locally. The average price of bottomfish imported from

Tonga was \$2.39/lb this year. Freight costs contributes to this high price but also reflects the failure of the local fleet to meet the demand as local consumers continue to buy these more expensive imports.

Figure 1. American Samoa bottomfish landings



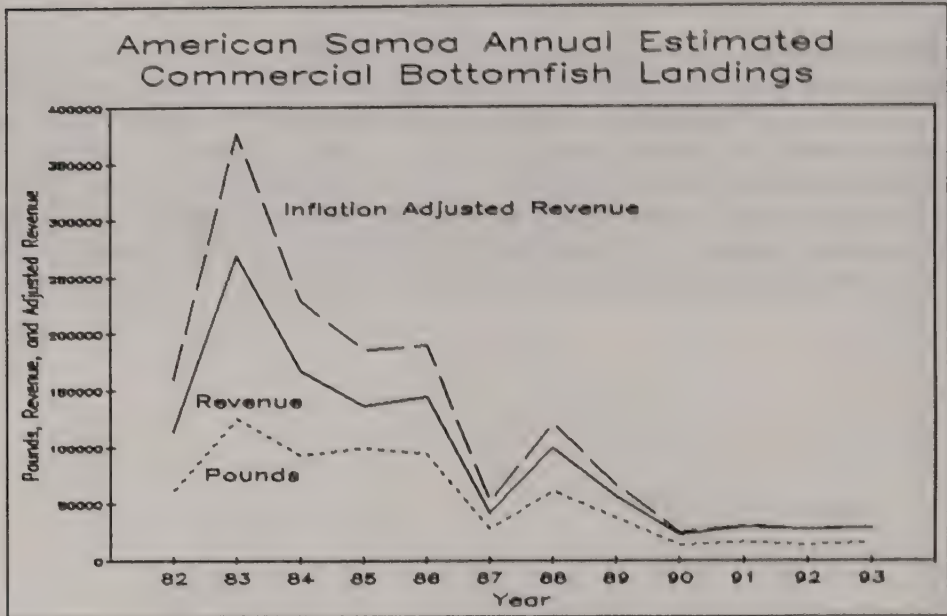
Year	Landings (lb)
1982	64,942
1983	126,327
1984	94,104
1985	103,114
1986	97,155
1987	30,640
1988	64,199
1989	49,279
1990	15,124
1991	17,934
1992	14,150
1993	16,785

Calculation: Bottomfish landings for 1982-84 are calculated by adjusting the sampled Tutuila data by the calculated annual percent coverage of the fleet, and then adding the similarly adjusted Manu'a landings. The 1986-present landings are from the creel survey expanded species composition files (*.SPC) which contain the annual estimated total landings by species for Tutuila, and then adding the adjusted Manu'a landings. Calculating statistics for 1985 is more complicated because the sampling program changed from commercial fleet

sampling only to creel sampling on October 1, 1985. Basically, monthly adjustments are made based on percent coverage for January to September, and the October to December *.SPC files are added, and then the adjusted Manu'a data are added.

Interpretation: The substantial declines in landings in 1987 and 1990 were partially due to vessel losses caused by two hurricanes. Boat repairs were delayed as fishermen repaired or rebuilt their houses. The increase (19%) in landings recorded this year was due primarily to an increased number of boats and effort (trip hours). Generally speaking, the bottomfish fishery is much smaller in recent years than it was any time between 1982 and 1986, a period when there was a relatively large fleet and fishermen were attracted to the profitable bottomfish export program. The slight increase in 1991 landings was followed by a decrease in 1992 caused primarily by a hurricane that struck American Samoa in December 1991.

Figure 2. American Samoa annual estimated commercial bottomfish landings



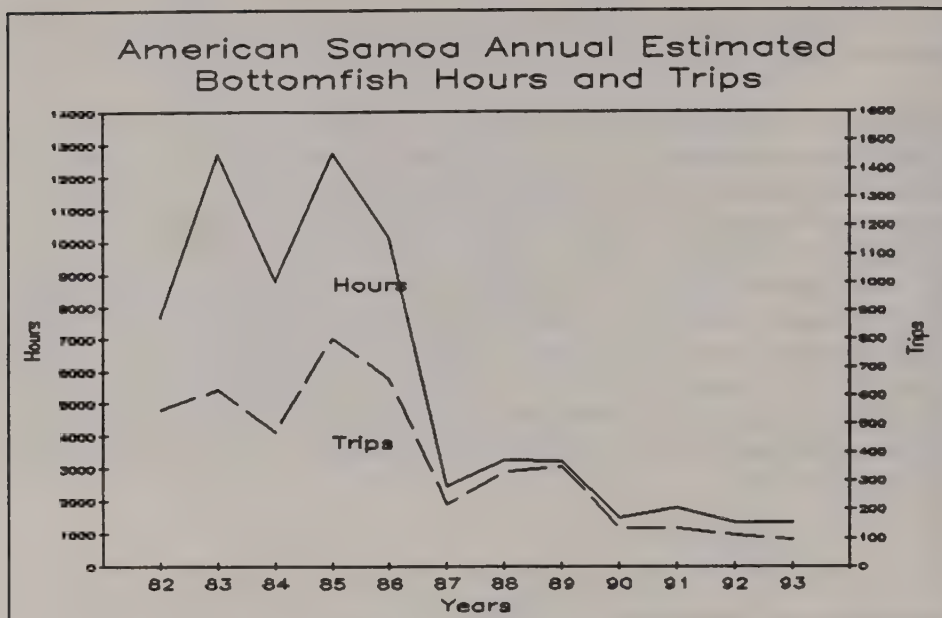
Year	Commercial Landings	Revenues	Inflation-Adjusted Revenues
1982	62,016	113,678	160,741
1983	125,167	269,083	377,523
1984	92,841	166,917	229,845
1985	99,214	136,799	186,594
1986	93,712	144,077	190,182
1987	27,618	41,089	51,977
1988	61,212	98,333	120,556
1989	37,475	56,650	66,564
1990	13,751	22,753	24,824
1991	16,421	29,558	30,888
1992	13,994	27,668	27,779
1993	16,004	28,984	28,984

Calculation: A relatively complex set of algorithms are used to estimate the commercial landings from estimates of total landings created by the creel survey data expansion system. In short, the percent sold by fishing method is calculated monthly and multiplied by the percent species composition by month, then multiplied by the estimated total landings for that

method and month. For 1982-85 sampling was conducted on the commercial fleet only (which included nearly all the fishing boats), whereas since 1985 creel sampling has covered all boats (commercial and recreational). Analysis of creel data for 1986-87 indicates that over 98% of the landed bottomfish were being sold. Therefore, it is believed to be valid to compare commercial data for years prior to 1986 to creel survey totals for years since 1986.

Interpretation: Commercial landings mirror the total fishery in declining catches in recent years. Relative to total landings, commercial landings decreased even more substantially in 1989, because the percent of the catch sold by bottomfish fishermen dropped from an average of about 97% in 1982-88 to 78% in 1989. The peak in 1983 portrays the high prices of deep water snappers exported to Hawaii, while the trough in 1987 can be attributed to effects of the 1987 hurricane. The slight increase in 1991 revenue was encouraging despite the continuous influx of imported bottomfish. In 1992 approximately 16,000 pounds of assorted bottomfish were imported from Western Samoa and Tonga, while only 9,400 pounds in 1993. The December 1991 hurricane contributed largely to the decreased landings and subsequently a decrease in revenues in 1992. Unfavorable weather continued through May 1992 hindering commercial bottomfish trips. Local commercial fishermen landed more fish in 1993 than in 1992.

Figure 3. American Samoa annual estimated bottomfish hours and trips



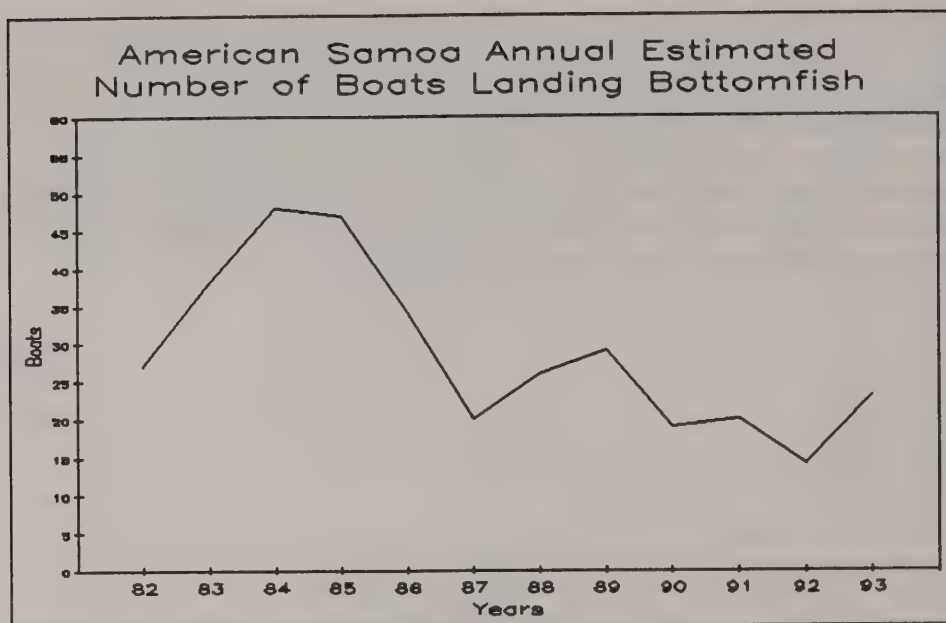
Year	Hours	Trips
1982	7,671	548
1983	12,695	621
1984	8,796	468
1985	12,740	804
1986	10,129	657
1987	2,458	217
1988	3,265	329
1989	3,215	349
1990	1,483	133
1991	1,798	136
1992	1,354	111
1993	1,363	95

Calculation: The annual estimated effort (hours) spent bottomfishing is calculated by dividing the annual estimated total bottomfish catch by the average CPUE (pounds per hour) from trips doing only bottomfishing. The annual estimated number of trips is calculated by dividing the estimated annual hours by the average length of a bottomfishing trip. The average length of a bottomfishing trip (not shown) is calculated by using only trips which

exclusively bottomfished and for which the trip length was recorded. The total hours fished from those trips is then divided by the number of trips. Recorded hours are trip hours.

Interpretation: The sharp decline in the bottomfish landings since 1986, noted in Fig. 1 is mirrored in this figure by a sharp decline in the level of effort expended in that fishery. Rather than indicating a problem with the resource, this decline depicts an actual trend of commercial boat owners and fishermen seeking other more lucrative and stable lines of work. A meager increase in the number of trips and hours occurred in 1991 followed by the 1992 decrease which can be attributed largely to the December 1991 hurricane that affected most of the bottomfishing vessels. The lowest number of trips ever recorded reflected a continued decline (since 1989) in profit and interest in bottomfishing.

Figure 4. American Samoa annual estimated number of boats landing bottomfish



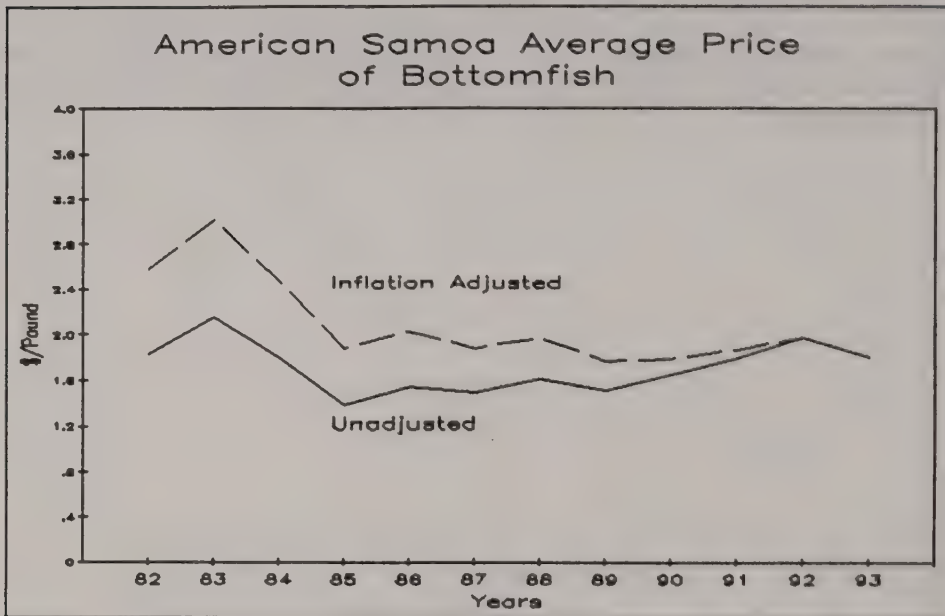
Year	Boats
1982	27
1983	38
1984	48
1985	47
1986	34
1987	20
1988	26
1989	29
1990	19
1991	20
1992	14
1993	23

Calculation: The annual estimate of the number of boats in the bottomfish fishery is obtained from the data base by counting the unique boats sampled during the year which landed any bottomfish species.

Interpretation: Again, the decline in the fishery since 1985-86 is noted by a decline in the number of boats participating in it. The 1987 hurricane caused the loss of the whole Manu'a

fleet, plus some of the Tutuila fleet. Several boats which contributed to the 1989 bottomfish annual landings did not land any bottomfish in 1990, due to much needed repairs and their participation in non-bottomfish chartered trips. Unfortunately, about 90% of the domestic fishing fleet was affected by the December 1991 hurricane, hence the decline in 1992. The increase this year is due mainly to the re-entry to the fishery of a few vessels after repairs, trips by two 14-foot vessels that did not bottomfish last year, and the entry of one new alia into the sampling area.

Figure 5. American Samoa average price of bottomfish



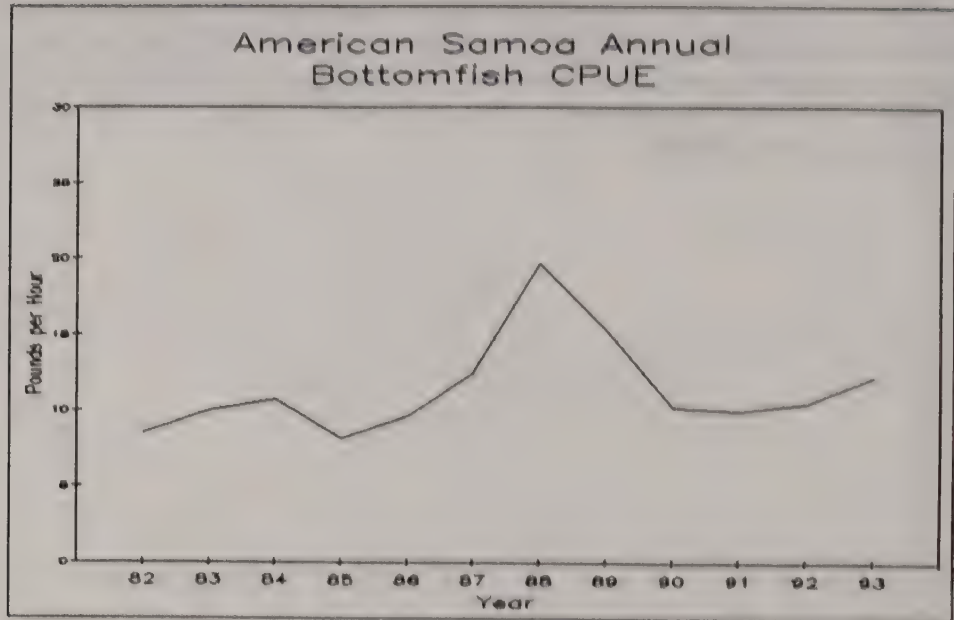
Year	\$/lb	Inflation-Adjusted \$/lb
1982	1.83	2.59
1983	2.15	3.02
1984	1.80	2.48
1985	1.38	1.88
1986	1.54	2.03
1987	1.49	1.88
1988	1.61	1.97
1989	1.51	1.77
1990	1.65	1.80
1991	1.80	1.88
1992	1.98	1.99
1993	1.81	1.81

Calculation: The average price of all bottomfish species combined is calculated by dividing total bottomfish revenue by total sold weight. The inflation adjusted price is calculated by multiplying the unadjusted annual average price by the annually calculated consumer price index (CPI) for American Samoa using the current year as the base. For example, the CPI for 1991 was 135.3 and that for 1986 was 107.1. To calculate the inflation adjusted average

price for 1986, multiply the unadjusted average price for 1986 by the 1991 CPI and divide by the 1986 CPI. The CPI for 1992 and 1993 were 140.9 and 141.4, respectively.

Interpretation: Prices were generally higher between 1982 and 1984 during the exportation of high-priced deepwater snappers to Hawaii. After this period, inflation-adjusted local prices have generally been stable. Price stability in recent years is a positive sign in light of the importation of bottomfish species from Western Samoa and Tonga. In 1993 the inflation-adjusted price per pound dropped.

Figure 6. American Samoa annual bottomfish CPUE



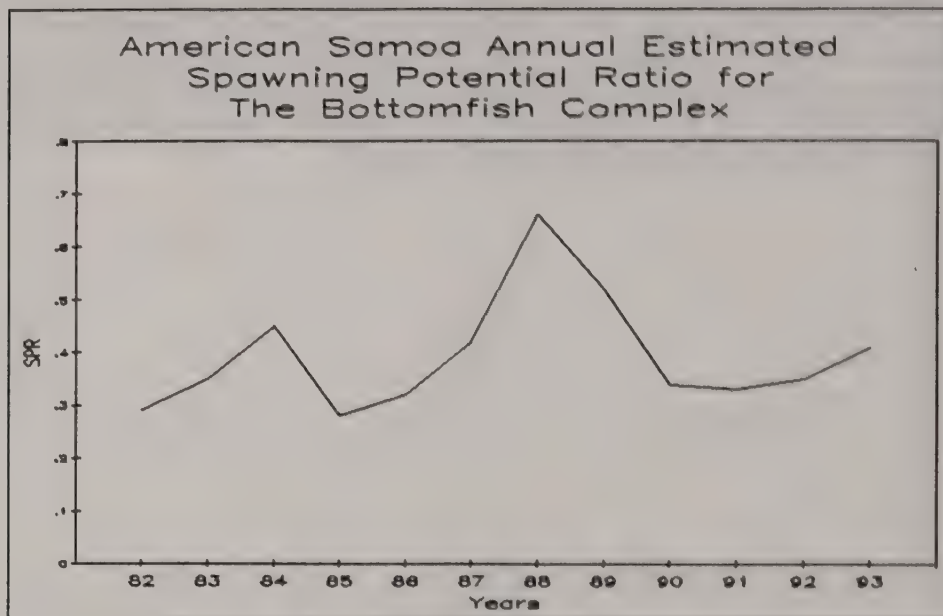
Year	CPUE
1982	8.5
1983	10.0
1984	10.7
1985	8.1
1986	9.6
1987	12.5
1988	19.7
1989	15.3
1990	10.2
1991	10.0
1992	10.5
1993	12.3

Calculation: CPUE (pounds per hour) is calculated using only trips in which only bottomfish were caught and effort was recorded. The average is calculated by using each CPUE from each trip as an observation and dividing by the number of trips.

Interpretation: The initial CPUE in 1983 and 1984 occurred during the intense fishing of some new fishing grounds for deepwater snappers exported to the more lucrative Hawaii

auction. A relatively high number of boats and local commercial fishermen participated in the fishery during this period. The drop in 1985 and 1986 might be expected following the ardent harvesting of the limited fishing grounds. Reasons for the CPUE peak in 1988-89 are unknown. The decline in CPUE from 1988 to 1990 can be partially attributed to a combination of some new, inexperienced fishermen entering the fishery and the exit of experienced and full-time commercial fishermen. CPUE has essentially remained stable during 1990 to 1992, with a 17% increase in 1993, despite concerns raised by some local fishermen that they are catching fewer bottomfish per trip.

Figure 7. American Samoa annual estimated spawning potential ratio for bottomfish complex



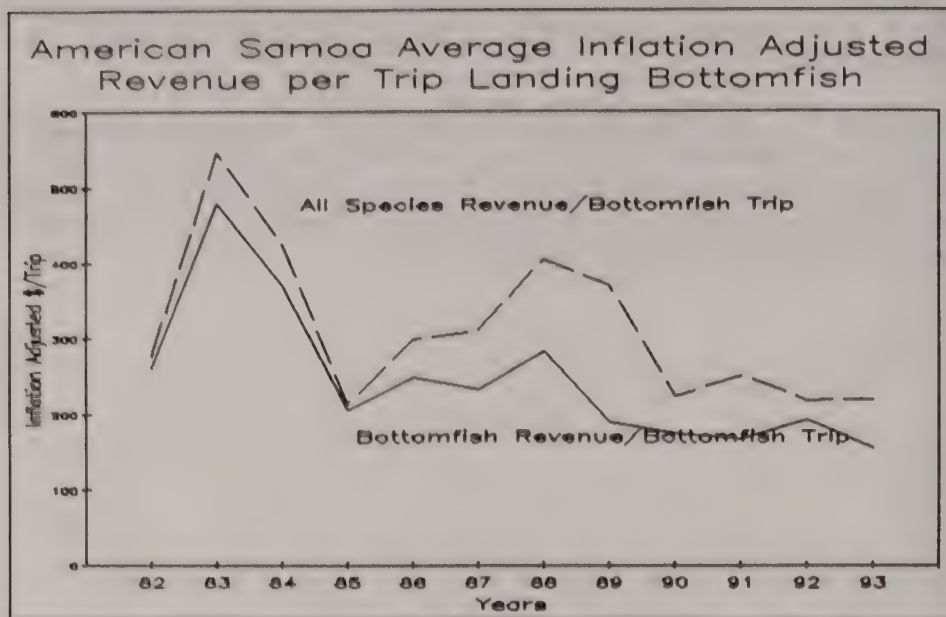
Year	SPR
1982	0.29
1983	0.35
1984	0.45
1985	0.28
1986	0.32
1987	0.42
1988	0.66
1989	0.52
1990	0.34
1991	0.33
1992	0.35
1993	0.41

Calculation: The spawning potential ratio is calculated by dividing the current year's CPUE by the virgin population CPUE, and then multiplying by the ratio of the current percent mature to the virgin population percent mature fish in the catch. To estimate SPRs for American Samoa, the "Dory" project mean CPUE for 1975 and 1976 combined (refer to 1990 annual report page 20, Table 3) was used (due to the relatively complete and consistent raw data recorded during this period) to estimate virgin population CPUE (14.8 lb/hr). Since

size and maturity data available for bottomfish in American Samoa are insufficient, the ratio of percent mature in the catch was estimated by substituting the average of the 5 species which have the lowest SPR in Hawaii. In this manner a "worst case" SPR was calculated to provide what should be a very conservative estimate of SPR for the American Samoa bottomfish complex.

Interpretation: The proxy "worst case" SPR for 1993 was 0.41, substantially above the 0.20 critical level. According to this indicator, the bottomfish complex of American Samoa is not considered to be recruitment overfished. Since the current estimation of American Samoa's SPR depend heavily on CPUE [refer to above **Calculations**], this year's SPR subsequently increased with this year's increase in CPUE.

Figure 8. American Samoa average inflation-adjusted revenue per trip landing bottomfish



Year	Bottomfish \$/Trip		All Species \$/Trip	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	185	261	196	277
1983	341	479	388	545
1984	269	370	309	425
1985	151	206	157	214
1986	189	249	226	299
1987	184	232	246	311
1988	231	283	331	405
1989	161	190	315	370
1990	161	175	205	224
1991	161	168	240	251
1992	192	192	217	218
1993	155	155	220	220

Calculation: The average revenue per trip for all species is calculated by summing the revenue of all sales for any trip which landed any bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trip is calculated from those same trips

by summing the sales of only bottomfish species and dividing by the number of trips. Figure 8 plots the inflation adjusted bottomfish and all species revenues per trip for the period 1982-92.

Interpretation: The distance between these two lines reflects the relative importance of bottomfish species in the total catch whenever any bottomfish are landed. The prominent importance of bottomfish between 1982 and 1985 occurred during the targeting of deepwater snappers for export. Bottomfishing was also the more profitable method of fishing during that period. The relative importance of bottomfish has generally been declining since 1985 as most of the full-time commercial fishermen quit the fisheries. The supply of locally caught bottomfish has been supplemented by the significant quantity of imported bottomfish. The December 1991 hurricane affected most of the fishing fleet and resulted in the noticeable decrease in the number of boats bottomfishing (Fig. 4). The decrease in bottomfish trips this year parallels the drop in bottomfish revenue per trip and could contribute to the declining interest in bottomfishing.

Appendix 2

Guam

Introduction

Guam is the largest (212 mi²) and southernmost (13°30' N, 144°50' E) island of the Mariana Archipelago. The northern portion of the island is distinguished by a high limestone plateau bordered by high, steep cliffs dropping into a very narrow shoreline. The southern part is characterized by a ridge of high hills on the west coast and low rolling hills on the east coast. Fishing activity on Guam is greatly influenced by weather. Four weather patterns have been identified, all of which are regulated by rainfall and winds rather than by variations in temperature. The "rainy" season lasts from late June through December, and the "dry" season from early January through most of June. There are also two wind condition periods: a trade wind (northeasterly winds) season that lasts from October through March, and the doldrums (calms and squalls) lasting from around April through September. Additionally, Guam is located within the typhoon belt and is thus periodically subjected to the damaging effects of typhoons (sustained winds > 75 mph) and super-typhoons (sustained winds > 150 mph). In general, most bottomfishing effort is conducted during periods of calm weather and seas, and therefore especially during the three to four months of the dry and doldrum seasons.

The northwestern coast and northern banks are the most heavily fished areas around Guam. This is due in large part to the fact that the eastern windward side of the island is too rough to fish nine months out of the year and that most of the population of Guam is located in the north central portion of the island. The Agana Boat Basin, centrally located on the western shore of Guam and in the capital, remains as the island's major small-boat launching point to access the leeward side of the island and the northern banks. The opening of the Agat Marina in 1989 has had an effect of shifting some of the boat launching activity in the south away from the Merizo Pier, the proportion of which has yet to be fully determined. Aside from providing slips for larger vessels and having more parking facilities for vehicles and trailers, the Agat Marina facilitates trailered boats from the north and central parts of the island a more convenient access point to the southwestern fishing areas than the Merizo Pier.

Guam's bottomfish fishery is a highly seasonal, combination small-scale commercial and subsistence fishery. The majority of the participants are part-time fishermen who operate vessels less than 25 feet in length and primarily target the shallow-water bottomfish complex. Historically, notable increases and declines in annual harvests have been caused by the respective entry and exit of full-time highliner vessels. These highliner vessels tend to be greater than 25 feet in length and their effort is usually concentrated on the deep-water bottomfish complex found around Guam's near-shore pinnacles and drop-offs and other such similar bottom structure adjacent to its offshore banks.

Guam has two distinct bottomfish fisheries which can be separated by depth and species. The shallow-water fishery (100-500 feet) contributes a larger portion of the overall

bottomfish harvest. However, this shallow-water fishery is for the most part limited to waters close to shore due to Guam's relatively steep bathymetry. This near-shore fishery is comprised of an assemblage of shallow-water snappers, emperors, groupers and jacks of the genera *Lutjanus*, *Lethrinus*, *Aprion*, *Epinephelus*, *Variola*, *Cephalopholis* and *Caranx*. The deep-water fishery (>500 feet) on the other hand, concentrates on snappers and groupers of the genera *Pristipomoides*, *Etelis*, *Aphareus*, *Epinephelus*, and *Cephalopholis*.

Most of Guam's fishermen who deep-water bottomfish usually combine some trolling effort for pelagic fish to supplement their total catch. In a majority of cases, the bottomfish catch is barely enough to meet the fisherman's own demand and thus often does not make it to market. Of the catch that is sold, a larger portion ends up in hotel restaurants, and the remainder ends up for sale to the local populace. Those fishermen involved in shallow-water bottomfishing are predominantly "weekend warrior" recreational and subsistence fishermen whose catch is seldom sold commercially.

The demand for both deep-water and shallow-water bottomfish continues to exceed the locally caught supply. Guam's deep-water bottomfish fishery, especially in the absence of highliner vessels, consequently has limited economic contribution. Furthermore, the cultural value of its shallow-water complex remains high due to the local popularity of this assemblage of fish as food items. Some of the demand for both complexes of bottomfish is offset with competitively-priced imports from other islands throughout Micronesia and from as far away as the Solomons. The quality, competitive pricing and consistent availability of imported fish effectively discourages local attempts to supplant foreign catches with Guam-caught fish.

The Bottomfish Management Unit Species (BMUS) for Guam are the following species: *Cephalopholis urodeta*, *Epinephelus fasciatus*, *Variola louti*, *Caranx ignobilis*, *Caranx lugubris*, *Seriola dumerili*, *Aphareus rutilans*, *Aprion virescens*, *Etelis carbunculus*, *Etelis coruscans*, *Lutjanus kasmira*, *Pristipomoides auricilla*, *Pristipomoides filamentosus*, *Pristipomoides flavipinnis*, *Pristipomoides seiboldi*, *Pristipomoides zonatus*, *Lethrinus rubrioperculatus* and *Lethrinus amboinensis*. For Table 1 *Cephalopholis urodeta*, *Epinephelus fasciatus*, and *Variola louti* comprise the grouper category; *Caranx ignobilis* and *Caranx lugubris* comprise the jack category; and *Lethrinus rubrioperculatus* and *Lethrinus amboinensis* comprise the emperor category.

Summary

An important consideration in reviewing the 1993 data for Guam's bottomfish fishery is the change in the methods utilized in expanding the data. Due to losses of staff, the normal expansion algorithms could not be used. The information presented was expanded by physical input of creel survey and commercial landings data into spreadsheets. Although the estimates are considered to be of equivalent accuracy, the accompanied statistics of confidence and partitioning of assorted catches by species were not possible. Due to the physical processing of annual data as opposed to the normal computer expansion, the mean length of fish for BMUS species could not be completed for the 1993 annual report. Once additional

staff have been acquired, the 1993 data together with unreported data from previous years will be keypunched and reanalyzed.

The analysis of the Guam bottomfish fishery does not show any problems through review of Fishery Management Plan descriptors or indicators. This is suspected to be the result of the continued use of small vessels which are limited by weather and moderate levels of effort in the fishery. The data collected and Plan Team indicators analyzed for Guam's bottomfish fishery once again show no need for management action for Guam's bottomfish fishery.

Due to a shortage of staff, no progress was made on the 1991 and 1992 annual report recommendations to conduct a study on the red-gilled emperor.

Recommendations

- 1) The 1992 and 1993 data is not completely representative of the data analysis required for the bottomfish report due in large part to the loss of the section's data processing specialist in 1992. The data processing and report generation thus will not meet the standards established for both the Western Pacific Regional Fisheries Management Council or the WPacFIN Cooperative Agreement. This deficiency continues to jeopardize both the integrity of the data and the funding of these programs. An effort to rectify this deficiency should be pursued quickly and the analysis of the available data repeated with the computerized expansion.
- 2) The need to complete a baseline biological survey for the red-gilled emperor still remains the single most important data deficiency for the Marianas shallow-water bottomfish resource and therefore the previous recommendation to establish a joint program with the CNMI remains a high priority.
- 3) A further recommendation is that Guam, with the assistance of the National Marine Fisheries Service, calculate the spawning potential ratio (SPR) for Guam and the Northern Marianas' deep and shallow-water bottomfish complex utilizing data previously collected from the 1981 "Typhoon" and/or the 1982-1984 "Townsend Cromwell" cruises.

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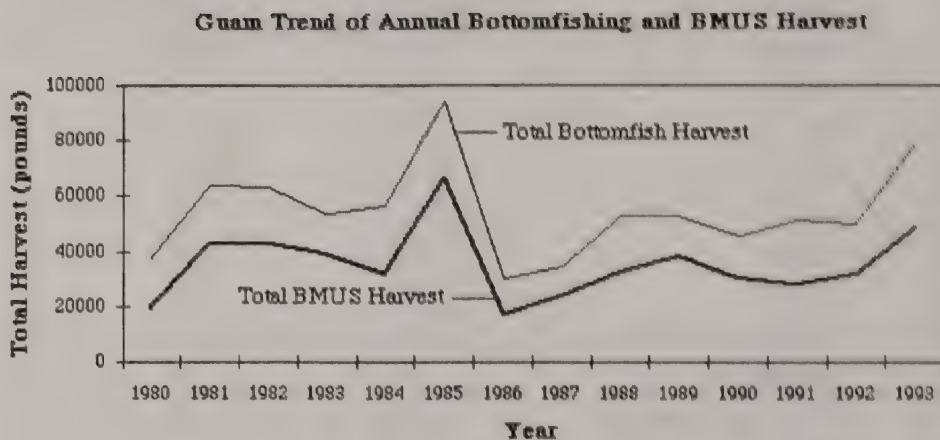
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Table 1. Guam 1993 creel survey composition of allocated bottomfish management species
(in pounds)

Species	All Methods	Bottomfishing only
Grouper	3569	3569
Jacks	2888	2082
Lehi	6939	6939
Uku	10056	10056
Ehu	2007	2007
Onaga	8172	8172
Taape	1177	1146
Yellowtail kalekale	4809	4809
Opakapaka	611	611
Yelloweye opakapaka	522	522
Kalekale	317	317
Gindai	3715	3715
Emperor	3712	3712
Amberjack	0	0
Total	48494	47657

Figure 1. Guam harvest of BMUS and all bottomfish



Year	Total Bottomfish Harvest (lb)	Total BMUS Harvest (lb)	BMUS Harvest by Bottomfishing (lb)
1980	37,399	19,252	19,145
1981	63,654	42,517	42,443
1982	63,442	43,428	42,678
1983	53,404	39,193	39,193
1984	56,998	32,232	32,089
1985	94,318	68,141	65,941
1986	30,368	17,969	17,069
1987	35,053	24,288	17,069
1988	52,791	33,724	23,828
1989	53,272	33,724	32,750
1990	45,374	31,295	30,515
1991	51,329	29,962	28,289
1992	50,099	34,057	31,745
1993	78,355	48,494	47,657

Source: The DAWR offshore creel survey data as expanded by computer based algorithms by method of fishing. All unidentified catch was allocated to species categories based on the species percentage of the total catch.

Calculation: The estimated total landings of the bottomfish species are selected from the creel survey expanded species composition files. However, the expanded estimates of catch by species must include at least a portion of the catch identified only by generic species codes categories. These generic categories (e.g. "mixed shallow bottomfish") also include some non-bottomfish species according to the FMP definition (e.g., squirrelfish).

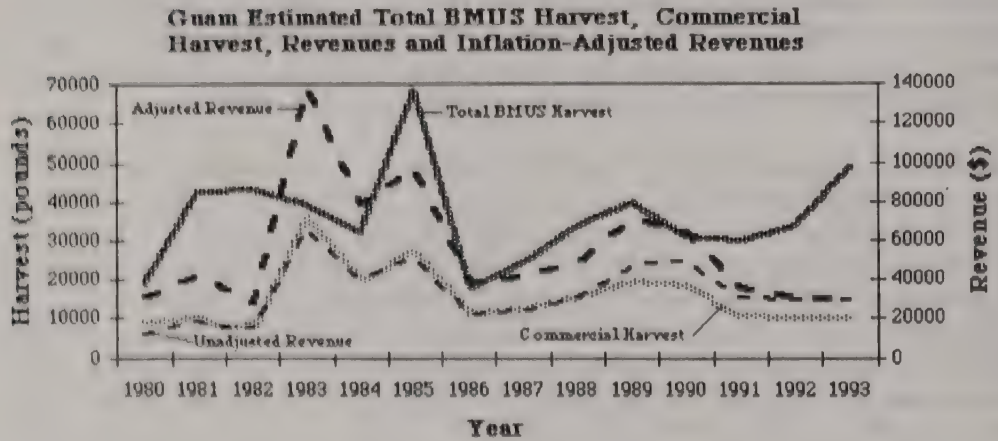
Interpretation: Fluctuations in the bottomfish landings on Guam are due primarily to changes in the fishery, not the fish stocks. The 1985 peak and apparent crash in 1986 were largely due to a few highliner fishermen who fished in 1985, but not in 1986. The overall effect that the opening of the Agat Marina in 1989 has had on Guam's bottomfishery remains to be determined, since a creel survey has yet to be established for this access point. Although boat trailer counts are taken at this facility, the ratio of bottomfish participants to other methods is not known for this area. It is suspected that the number of bottomfishing boats departing from the Agat Marina is actually higher than the number of bottomfishing boats leaving from the Agana Boat Basin. The 1993 increases in both the total bottomfish harvest and total BMUS harvest, 56% and 42% respectively, is thought to be directly linked to the 57% increase in the estimated number of boats participating in bottomfishing between 1992 and 1993 (see Fig. 4).

Table 2. Guam 1993 commercial bottomfish average price

Species	Average \$/lb
Bottomfish	2.91
Grouper	2.55
Jacks	2.26
Lehi	2.87
Uku	2.43
Ehu	3.23
Onaga	4.74
Opakapaka	3.02
Kalekale	2.96
Gindai	3.08
Emperor	2.68
All Bottomfish Species	2.90

Note: The source of this information is different than the values presented for harvest and therefore the species covered may vary slightly between data bases.

Figure 2. Total and commercial BMUS harvest, and revenue



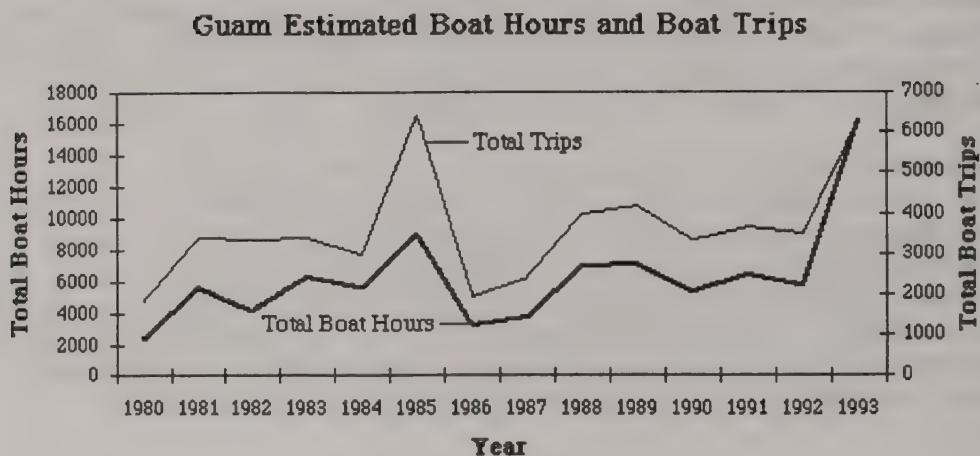
Year	Total BMUS Harvest (lb)	Commercial BMUS Harvest (lb)	Unadjusted Revenue (\$)	Inflation-adjusted Revenue (\$)
1980	19,253	9,381	11,458	31,888
1981	42,517	10,459	18,590	42,943
1982	43,428	6,617	12,753	28,018
1983	39,193	36,281	65,543	139,213
1984	32,232	20,115	40,176	78,464
1985	68,141	27,064	51,777	97,340
1986	17,969	11,482	21,289	38,979
1987	24,288	12,639	23,551	41,285
1988	33,724	15,792	29,568	49,260
1989	39,814	19,442	47,029	70,637
1990	31,295	18,390	48,983	64,413
1991	29,962	10,773	30,234	36,069
1992	34,057	10,344	29,410	31,851
1993	48,494	10,125	29,348	29,348

Source: The estimated total landings are from the DAWR creel survey system, and the commercial data are from the WPACFIN originated commercial landings system.

Calculation: The creel survey data are the same as in the first figure. The total commercial bottomfish landings and revenue for each year were calculated by summing the weight and value fields in the commercial landings data base and then multiplying by an estimated percent coverage expansion factor. This annual expansion factor was subjectively created based on as many factors as possible depending on the year, including: an analysis of the "disposition of catch" data available from the DAWR offshore creel survey; an evaluation of the fishermen in the fishery and their entry/exit patterns; general "dock-side" knowledge of the fishery and the status of marketing conditions and structure; the overall number of records in the data base; and a measure of the best educated guess.

Interpretation: The major fluctuations in the bottomfish fishery are believed to be fishery-based, not stock-based. This is due to the relatively small size of the bottomfishing fleet and frequent changes in the actual participants. Conducting offshore creel surveys at the Agat Marina, once additional manpower is acquired, will help to provide a better representative sample of total bottomfish harvest. The negligible decrease in the commercial harvest and adjusted revenue between 1992 and 1993 seem to indicate that the 42% increase in the total BMUS harvest in that same period may be due primarily to an increase in the number of recreational and subsistence fishermen entering the bottomfish fishery.

Figure 3. Estimated boat hours and trips



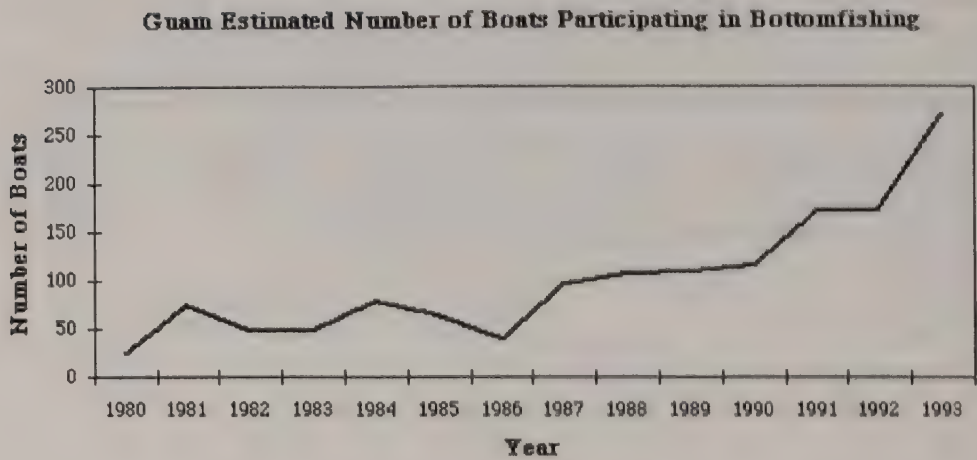
Year	Total Boat Hours	Total Trips
1980	4,752	929
1981	8,804	2,150
1982	8,621	1,606
1983	8,699	2,401
1984	7,730	2,160
1985	16,477	3,471
1986	5,018	1,246
1987	6,264	1,447
1988	10,208	2,653
1989	10,818	2,732
1990	8,628	2,060
1991	9,440	2,444
1992	9,072	2,234
1993	16,238	6,265

Source: The DAWR creel survey data for the method bottomfishing.

Calculation: The estimated number of boat trips and boat hours for the bottomfishing method are derived directly from the creel survey expansion algorithms.

Interpretation: These two measures of effort nearly mirror each other and the previous figure for catch. The apparent increase in boat trips and boat hours since 1991 may be the result of an increase in the sampling effort with the inclusion of the Merizo Pier as a survey site since 1991, as well as a concomitant increase in bottomfish participation due to the opening of the Agat Marina in 1989. The rash of typhoons and inclement weather that hit Guam between 1990 and 1992 may have suppressed the expected trend of a steady increase in the number of boat trips and boat hours spent bottomfishing. The return of normal to fair weather patterns in 1993 and a 57% increase in the estimated number of boats participating in bottomfishing between 1992 and 1993, best explains the dramatic increase in the number of boat hours and boat trips for the same time period (see Fig. 4).

Figure 4. Guam bottomfish fishery participation



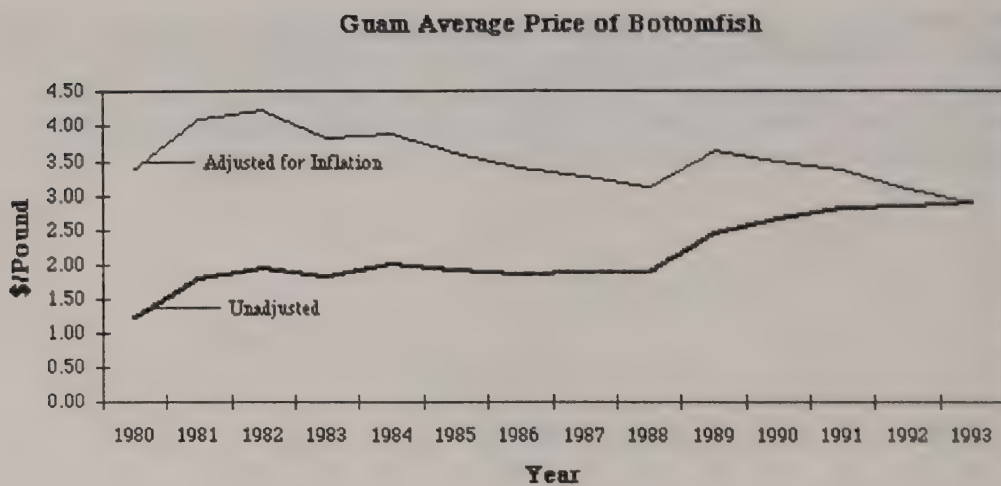
Year	Number of Boats
1980	24
1981	75
1982	49
1983	48
1984	79
1985	63
1986	39
1987	96
1988	107
1989	110
1990	116
1991	173
1992	173
1993	271

Source: DAWR offshore creel survey data from Agana Boat Basin

Calculation: The "threshold" C/E model was run a minimum of 15 times per year and the median estimated number of boats is presented above. These numbers should be considered as conservative estimates because boats which use unsurveyed launch sites will never be encountered and because surveys are conducted on only 13% of the possible days.

Interpretation: Over the last several years the number of boats in this fishery has increased steadily. The approximately 57% increase between 1992 and 1993 is thought to be the result of an increase in the sampling effort with the inclusion of the Merizo Pier as a survey site since 1991, a healthy economy that has made it possible for more residents to afford boats, and a return of fair weather that allowed for more favorable fishing conditions.

Figure 5. Average bottomfish prices



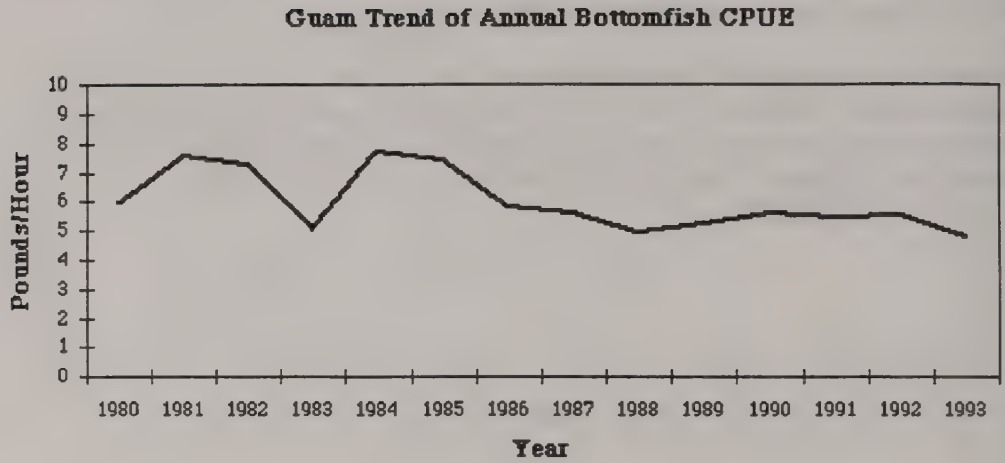
Year	Unadjusted \$/lb	Adjusted \$/lb
1980	1.22	3.40
1981	1.78	4.11
1982	1.93	4.23
1983	1.81	3.84
1984	2.00	3.90
1985	1.91	3.60
1986	1.85	3.39
1987	1.86	3.27
1988	1.87	3.12
1989	2.42	3.63
1990	2.66	3.50
1991	2.81	3.35
1992	2.84	3.08
1993	2.90	2.90

Source: The commercial landings data from the major wholesaler.

Calculation: The average price of all bottomfish species combined is calculated by dividing the total bottomfish revenue by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the 1993 figure as the base from which to calculate expansion factors for all previous years (e.g. divide the 1993 CPI by the CPI for any given year). Then you multiply the unadjusted average price by this factor to obtain the adjusted average price for the given year.

Interpretation: The adjusted average price for bottomfish has not shown consistent marketing trends. This is expected to have resulted from the seasonal supply of pelagic fish and difficulties in developing a consistent market for locally caught fish. In addition, imported fish from other islands around the region has contributed to the continued marketing problem for local fishermen.

Figure 6. Guam bottomfish CPUE



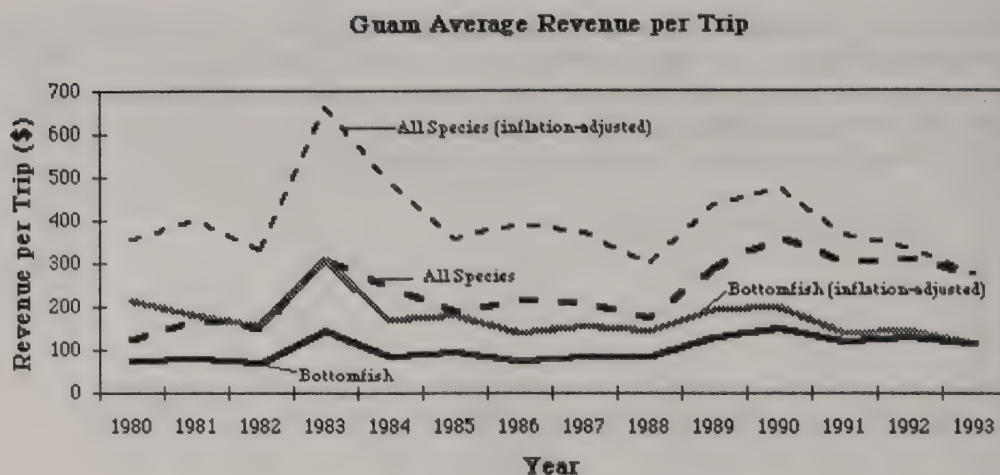
Year	CPUE (lb/hr)
1980	5.9
1981	7.6
1982	7.3
1983	5.1
1984	7.7
1985	7.5
1986	5.8
1987	5.6
1988	5.0
1989	5.3
1990	5.6
1991	5.4
1992	5.5
1993	4.8

Source: The DAWR creel survey data for the bottom fishing method.

Calculation: The catch per hour for each bottomfish fishing trip surveyed is treated as a separate observation in calculating the average CPUE for the bottomfishing method. The sum of the individual trip CPUE's for surveyed trips is divided by the total number of surveyed trips.

Interpretation: The annual CPUE fluctuates around 5 and 8 lb/hr, but has been fairly stable for the past eight years. The slight decrease in the total CPUE between 1992 and 1993 is likely due a reduction in the CPUE of the shallow-water bottomfish complex since most of the new and presumably inexperienced bottomfishing participants target the shallow-water complex. Overall, no problems are indicated by CPUE trends.

Figure 7. Guam average revenue per trip



Year	\$/Trip - Bottomfish		\$/Trip - All Species	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1980	77	215	129	359
1981	80	184	174	403
1982	71	157	152	334
1983	147	312	312	662
1984	87	170	248	485
1985	96	181	190	357
1986	78	143	215	393
1987	88	155	212	372
1988	87	146	178	297
1989	132	198	290	435
1990	154	202	363	478
1991	120	143	308	368
1992	134	146	311	337
1993	118	118	277	277

Source: The commercial landings data from major wholesalers.

Calculation: The average revenue per trip for all species is calculated by summing the revenue of all species sold for any trip which landed bottomfish species, and dividing by the

number of trips. The average bottomfish revenue per trips is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips.

Interpretation: The adjusted average revenue per trip does not appear to show any single long term trends. The increase in the amount of imported bottomfish from around Micronesia (Palau, Chuuk, Pohnpei, etc.) that began sometime around 1991 with the addition of airline routes to Guam may explain the slight decrease in the revenue over the last several years.

Appendix 3

Hawaii

Introduction

The commercial bottomfish stocks in the Hawaiian Islands are divided into two fisheries: seamount groundfish and deep-slope bottomfish. The seamount fishery targets alfonsoin, *Beryx* spp., and armorhead, *Pseudopentaceros wheeleri*. The only area in the US EEZ for this fishery is Southeast Hancock Seamount located 1,400 nm northwest of Honolulu. This trawl fishery was started by the Russians and Japanese in the late 1960s and large catches were made for about 10 years causing a crash in the fishery. This fishery has never been domestically harvested. A moratorium on fishing within the US EEZ began in 1986 and continues through the present with no substantial recovery in the fishery observed.

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 50-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. The deep-slope fishing grounds within the US EEZ are divided into three management zones. The inhabited main Hawaiian Islands (MHI) support numerous subsistence, recreational, and commercial fishermen with considerable overlap by category. The uninhabited Northwest Hawaiian Islands (NWHI) are divided into the Mau Zone, closer to the MHI, and the Hoomalu Zone. Fishing in these zones is conducted solely by commercial fishermen and requires federal licensing for such activities. The Hoomalu Zone is a limited entry zone with 4 vessels participating in 1993; 8 vessels fished the Mau Zone in the same year.

Vessel size varies considerably with larger fully commercial vessels (30 ft in length and over) conducting trips of about 10 days, and smaller vessels (<30 ft) generally restricted to the MHI and trips of 1-3 days. Most vessels in this fishery are fully outfitted with electronic navigation and fish-finding equipment, as well as with electric or hydraulic line-hauling equipment. The catch is sold fresh in the round for local consumption.

Catch and revenue data for bottomfish has been collected by the State of Hawaii Division of Aquatic Resources (HDAR) since 1947 in the form of a report submitted by commercial fishermen. No data is collected for recreational or subsistence fishermen, but their catch is estimated to be about equal to the commercial catch in the MHI. Data obtained from a market monitoring program and data from fishermen interviews are combined with the HDAR data set for the analysis presented in this report.

Summary

The Main Hawaiian Island bottomfish fishery has remained relatively stable over the last few years. Landings dropped sharply in 1993 as compared to 1992 due to a similar drop in effort (CPUE remained nearly constant). Stocks of many of the BMUS species in this zone are stressed. Onaga is overfished by definition since the SPR is below 20%. Other species have yellow light conditions due to drops in CPUE below 50% of original values. In the case of ehu in the MHI, CPUE is down to about 5% of original, clearly deserving of concern.

Bottomfish stocks in the NWHI appear to remain healthy. CPUE is 34% of the original level in the Mau Zone but is much greater than that in the Hoomalu zone. Analysis of SPR and percent immature in the catch show no problems to date.

Armorhead stocks outside of the US EEZ experienced a short pulse in recruitment in 1992 which did not carry over into 1993. SPR values at Southeast Hancock Seamount are the highest since 1986, but at 2.5% they still indicate a collapsed fishery.

Recommendations

- 1) In light of the Council's decision for the State of Hawaii to take lead responsibility for managing bottomfish, the BPT understands its responsibility to be monitoring and reporting of the status of the fishery in the MHI and identifying where problems occur, but no longer to identify and evaluate various management options.
- 2) Again, remind the State of the continuing serious condition of MHI onaga (now recruitment overfished for the past 5 years), and encourage it to correct the situation through soonest possible action. Also, inform the State that opakapaka is now on the borderline of being overfished ($SPR = 0.21$) and ehu is in a yellow-light condition with CPUE reaching less than one-tenth its original level.
- 3) The BPT expresses severe reservations regarding the effectiveness of the new catch reporting system (old C-3 form together with the State's new Trip-Sales Report) being implemented for the NWHI fishery. Of most concern is critical information that will be missing on interactions with protected species, loss to predation and line-hours of effort fished, in addition to the increased difficulty for fishermen to fill out these forms. The BPT requests that NMFS provide a complete report on the progress and effectiveness of this new catch reporting system by 1 March 1995, with adequate detail on data providing catch per day vs. catch per trip, total number of trips captured by the data form, comparison of pounds caught (from catch reports) vs. catch monitoring (by NMFS).
- 4) Proceed with the minor regulatory changes recommended by NMFS-Office of Enforcement to: 1) Modify 50 CFR 683.21(b) to explicitly prohibit bottomfish fishing in the Mau Zone without a permit; 2) Modify 50 CFR 683.6(e) to explicitly require NWHI bottomfish vessels to visibly display their official number (similar to other fisheries); 3) Require fish dealers to make all records involving catch from permitted vessels available for

federal inspection; and 4) Attempt to clarify any other regulations so more easily understood.

5) Again, strongly encourage the State to proceed expeditiously with computerization of the fish and seafood dealer reporting system and integrate this with the fishermen's commercial catch reporting system.

6) Again, strongly encourage NMFS and the State to increase the level of bottomfish catch monitoring of the Honolulu auction (reduced from 6 to 2 days per week) and expand this sampling to major dealers on all other main Hawaiian Islands.

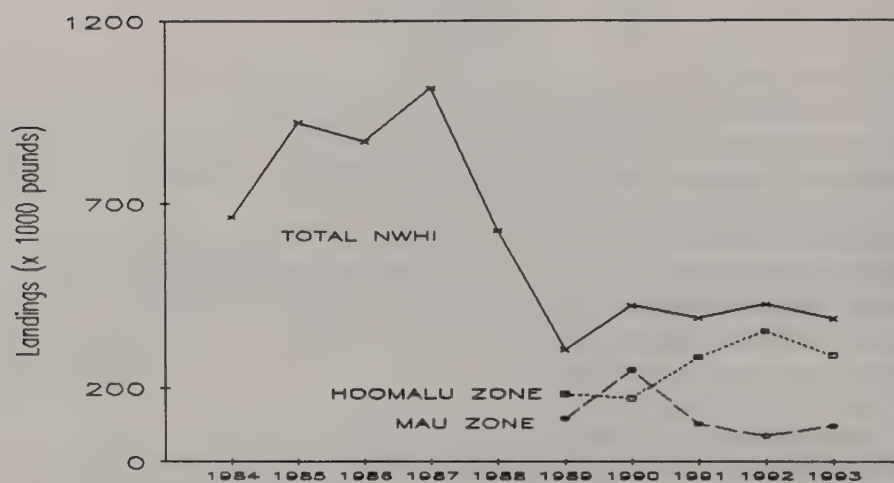
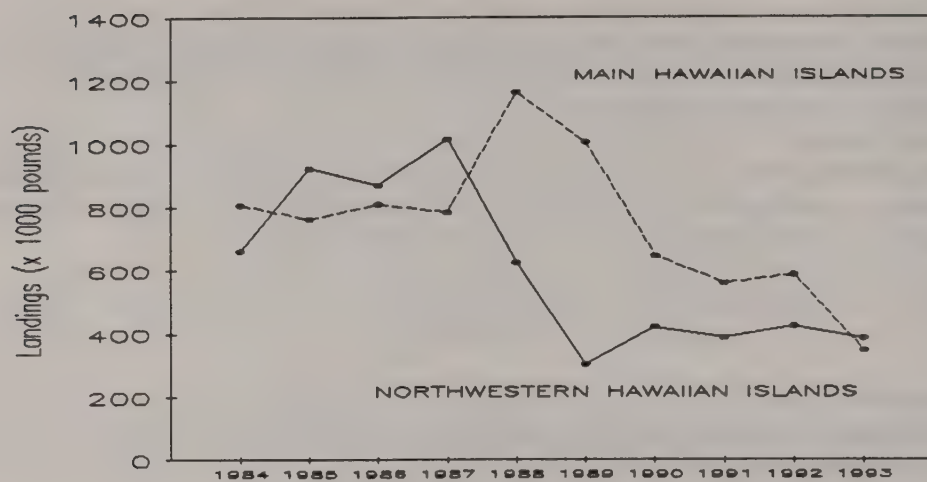
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Figure 1. Hawaii's bottomfish landings from the NWHI and MHI



Area	Landings (1000 lb)			
	Mau	Hoomalu	Total NWHI	MHI ²
1984	NA	NA	661	807
1985	NA	NA	922	763
1986	NA	NA	869	810
1987	NA	NA	1015	783
1988	NA	NA	625	1164
1989	118	184	303	1006
1990	249	173	421	645
1991 ¹	103	283	387	561
1992 ¹	71	353	424	587 ³
1993 ¹	98	287	385	348 ³

¹ NWHI data from combination NMFS and HDAR

² Data from HDAR

³ Preliminary data

Source: NWHI landings data for 1984-90 collected by National Marine Fisheries Service (NMFS) Honolulu Laboratory's market monitoring program. The 1991-93 NWHI landings are a combination of NMFS and HDAR data. MHI landings are from HDAR data. Data for bottomfish includes BMUS and other bottomfish.

Calculation & Adjustment: NMFS data are presented as an expanded estimate to approximate the total market volume. Market expansion factors are based on a 1979 survey of wholesale markets in Hawaii and on the landing patterns of specific fleets. The 1991-93 data set is a combination of the NMFS and HDAR data which has been adjusted to account for missing trips. MHI landings are unadjusted for recreational landings.

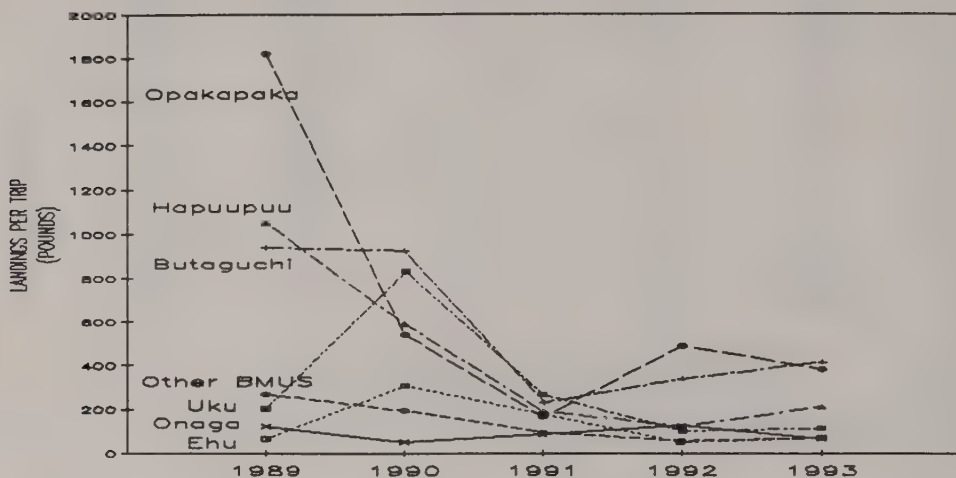
Comments: The overall 1993 NWHI landings showed a decrease back to the 1991 level. Preliminary data for the MHI landings exhibited a large decrease and for the first time in 6 years dropped below those of the NWHI.

The Mau Zone had an increase in trips which resulted in increased landings. The Hoomalu Zone experienced a large decrease in landings while having only 3 less trips.

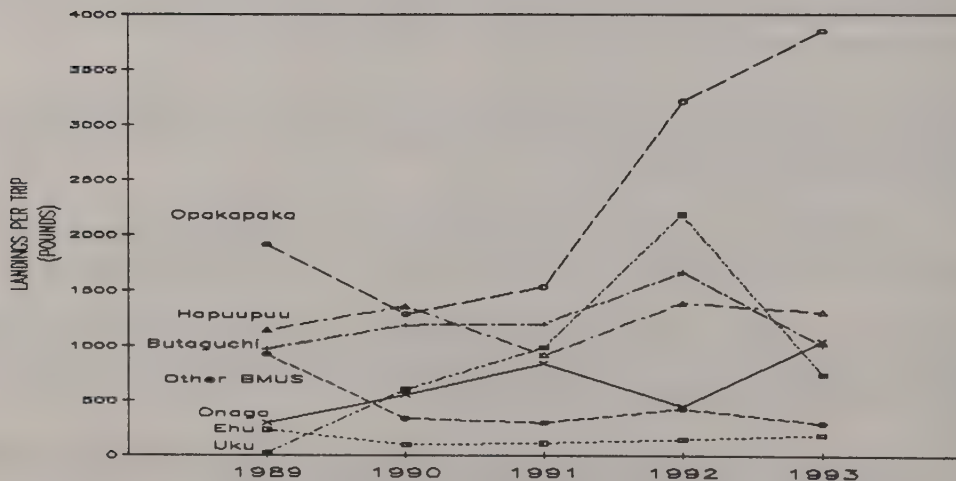
Interpretation: Trends in landings have generally followed trends in effort for the various fishing zones (see Figs. 6 and 8). Deviations from this relationship exhibited in the last 7-8 years have been attributed to the abundance of uku.

The landings of uku has been responsible for the high volume of landings in 1988 for the MHI, in 1990 for the Mau Zone and in 1992 for the Hoomalu Zone.

Figure 2. Northwestern Hawaiian Islands BMUS species composition of landings per trip, by weight, for the Mau and Hoomalu Zones



Mau Zone Landings per Trip, 1989-1993.



Hoomalu Zone Landings per Trip, 1989-1993.

NWHI BMUS average pounds per trip by species, Mau Zone

Species	1989	1990	1991¹	1992¹	1993¹
Opakapaka	1820	541	163	488	382
Onaga	120	49	83	124	66
Ehu	65	309	176	48	69
Hapuupuu	1050	590	189	121	210
Butaguchi	938	923	228	336	415
Uku	202	830	266	100	112
Other BMUS	268	193	94	56	67
Total per trip	4463	3435	1199	1273	1321

¹ Data from combination of NMFS and HDAR data sets.

NWHI BMUS average pounds per trip by species, Hoomalu Zone

Species	1989	1990	1991¹	1992¹	1993¹
Opakapaka	1910	1284	1530	3208	3849
Onaga	293	550	837	450	1042
Ehu	231	94	113	148	185
Hapuupuu	1138	1357	913	1386	1305
Butaguchi	969	1185	1196	1660	1004
Uku	20	600	985	2187	736
Other BMUS	920	333	297	425	291
Total per trip	5481	5403	5871	9464	8412

¹ Data from combination of NMFS and HDAR data sets.

Source: Data for 1991-93 are from a combination of NMFS and HDAR data.

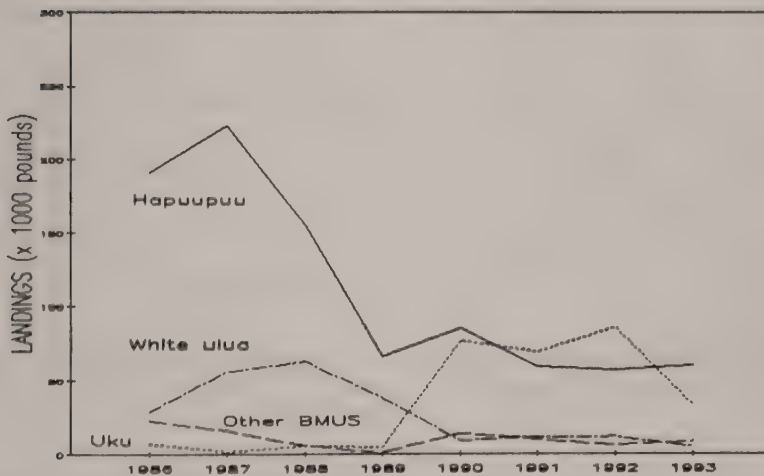
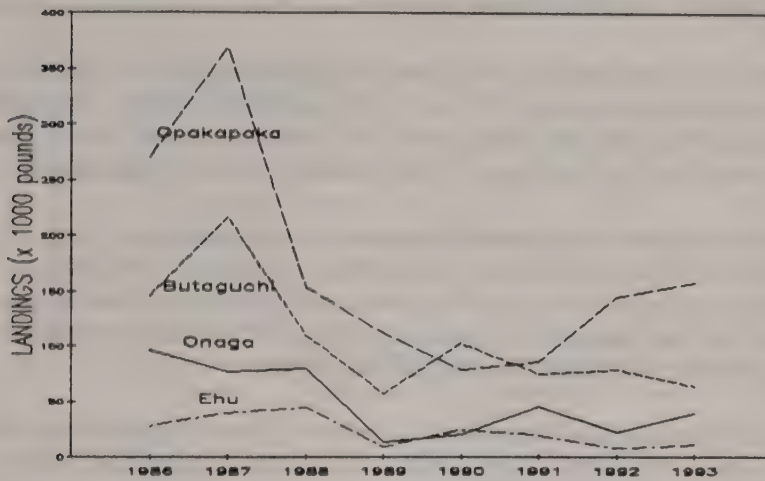
Comments: Per trip landings for the Mau Zone have increased slightly over last year. Landings of the major target species (opakapaka and onaga), however, have decreased in this zone while landings of the secondary target species (butaguchi and hapuupuu) have increased. The strong uku landings of 1990 have dropped almost back to the pre-run levels.

Landings for the Hoomalu Zone have shown about a 1000 pound decrease in landings per trip. The uku landings have decreased substantially from the 1992 peak.

Interpretation: The large reduction in catch per trip observed in the Mau Zone after 1990 is thought to be due to the change in the data source and may not reflect abundance of the stock. Starting in 1991 many shorter, low volume trips, that were not recorded prior, were included in the data set. Additionally, the uku catches have returned to normal after a 1990 peak in the Mau Zone.

Decreased landings from the areas fished in 1992 has prompted vessels in the Hoomalu Zone to fish farther up the island chain. As a result the opakapaka and onaga landings from this zone have increased as "new" old grounds are being rediscovered. Large reductions in per trip uku landings reflect a return toward normal after a 1992 peak.

Figure 3. NWHI BMUS species composition of landings by weight



Species	1986	1987	1988	1989	1990	1991 ¹	1992 ¹	1993 ¹
Opakapaka	297	370	154	112	79	86	145	158
Onaga	106	77	80	13	21	46	23	40
Ehu	30	40	45	9	25	20	8	11
Hapuupuu	210	223	156	66	85	59	57	59
Butaguchi	160	217	111	57	103	75	79	64
Uku	7	2	6	5	77	69	86	33
White ulua	29	56	63	38	9	12	12	5
Other BMUS	23	16	6	1	14	10	6	14

¹ Data from a combination of NMFS and HDAR data.

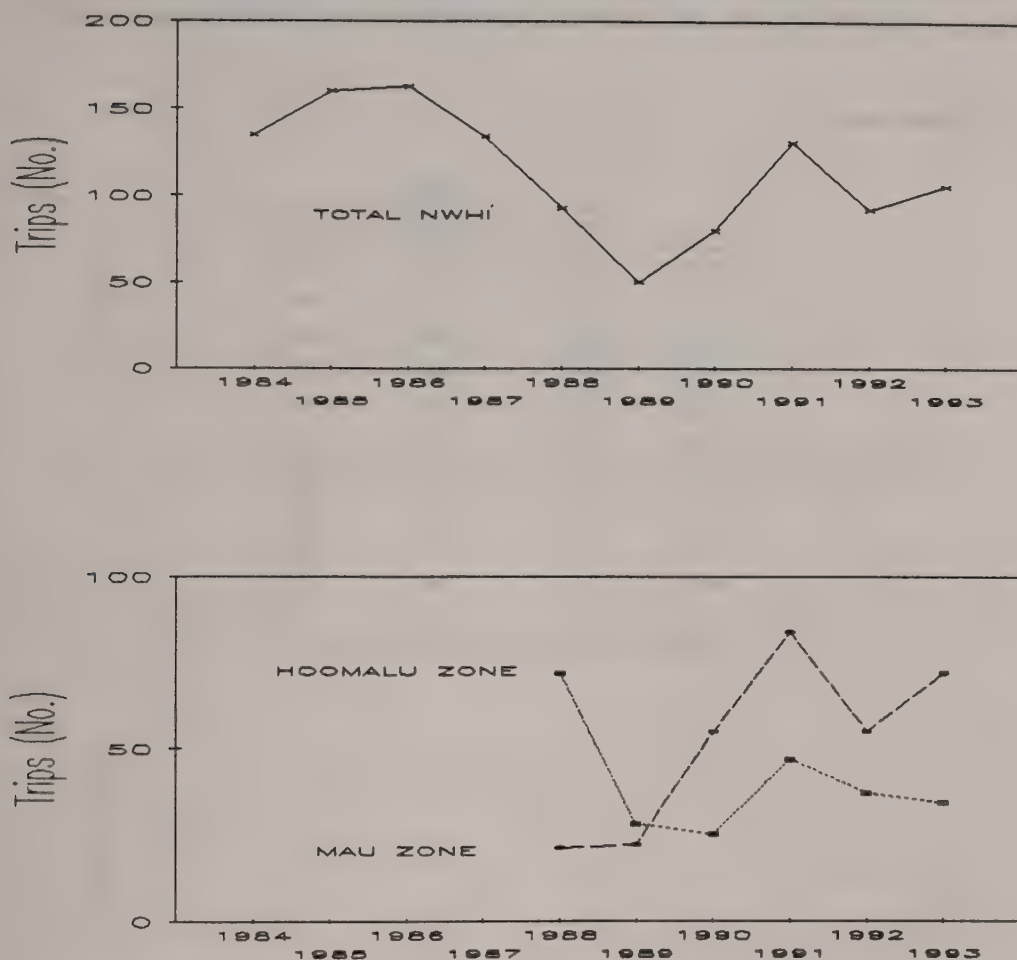
Source: Landings data collected by Honolulu Laboratory's market monitoring program. Data from 1987-1990 are expanded NMFS estimates. The 1991-1993 data are from a combination of NMFS and HDAR data.

Interpretation: Opakapaka and especially onaga landings were on the rise in 1993 after being targeted to a lesser extent in 1992 due to the abundance of uku. The uku landings which peaked in 1990 in the Mau Zone and in 1992 in the Hoomalu Zone appear to be decreasing to prerun levels. Landings of other bottomfish have remained relatively stable.

Butaguchi landings have decreased somewhat and, although this may not be an indication of any stock related decrease, the numbers of released butaguchi can be great at times and represent a large quantity of valuable resource that should not be wasted. Tagging of released fish has been suggested by some fishermen. The fishing mortality and its effect on the stock stemming from these releases are not known.

Butaguchi have a shelf-life problem, as well as a low value, and often are discarded during the early part of the trip. They are kept during the latter part of the trip to balance out the load or to "make weight" when more valuable species cannot be caught.

Figure 4. Number of trips made by NWHI bottomfish fleet, Mau and Hoomalu Zones



Source: Trip data collected by Honolulu Laboratory's monitoring program. The 1991-1993 data are the result of a combination of NMFS and HDAR data sets.

Interpretation: The limited entry program started in 1989. The 1990 number of Mau Zone entrants increased due to the limited access into the Hoomalu Zone. The increase in participation consequently resulted in an increase in the number of trips. In 1991 the Mau Zone shows a trip count increase which is due to the combined data set used. The hurricane "Iniki" that hit the Hawaiian island chain during the latter part of 1992 severely restricted the activities of the Kauai based fishing fleet for part of the 1993 season. Although many of the Kauai vessels did not restart fishing, for one reason or another there were several new Oahu-based vessels that entered the fishery. A couple of the Oahu-based vessels did increase their participation over previous years.

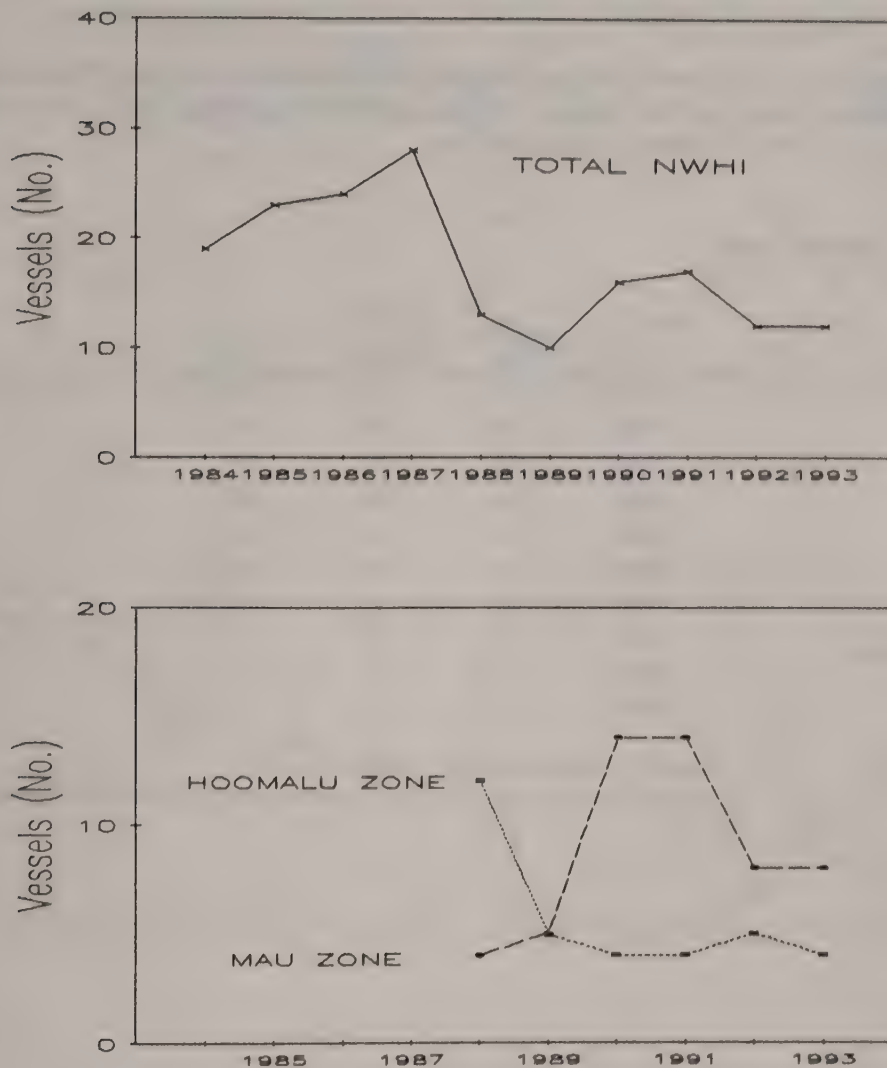
The Hoomalu Zone fleet made nearly the same number of trips (less 3 trips) as in 1992 with one less vessel. The vessel was lost at sea while on a longline fishing trip. It averaged about 3-4 trips per year during its participation in the NWHI bottomfish fishery.

Figure 4 data summary:

Year	Trips		
	Mau	Hoomalu	Total
1984	NA	NA	135
1985	NA	NA	160
1986	NA	NA	163
1987	NA	NA	134
1988	21	72	93
1989	22	28	50
1990	55	25	80
1991 ¹	84	47	131
1992 ¹	55	37	92
1993 ¹	72	34	106

¹ Based on combined NMFS and HDAR data.

Figure 5. Number of vessels in the NWHI bottomfish fleet, Mau and Hoomalu Zones



Source: Vessel participation data collected by Honolulu Laboratory's market monitoring program. The 1991-93 data are the result of a combination of NMFS and HDAR data sets.

Comments: The number of vessels participating in the NWHI bottomfishery has remained nearly at the same level as in 1992.

Some of the Kauai Mau Zone vessels have not been fishing but other Oahu based vessels have filled the void.

The Hoomalu Zone vessel participation has also remained nearly constant as the limited entry program remains in effect. One part-time bottomfish vessel (usually a pelagic longline vessel) was lost.

Interpretation: The increase of vessels experienced in 1990-1991 was due to the limited entry program, started in 1989, forcing all new entrants into the Mau Zone. The level of participation in 1992-93 seems to have stabilized.

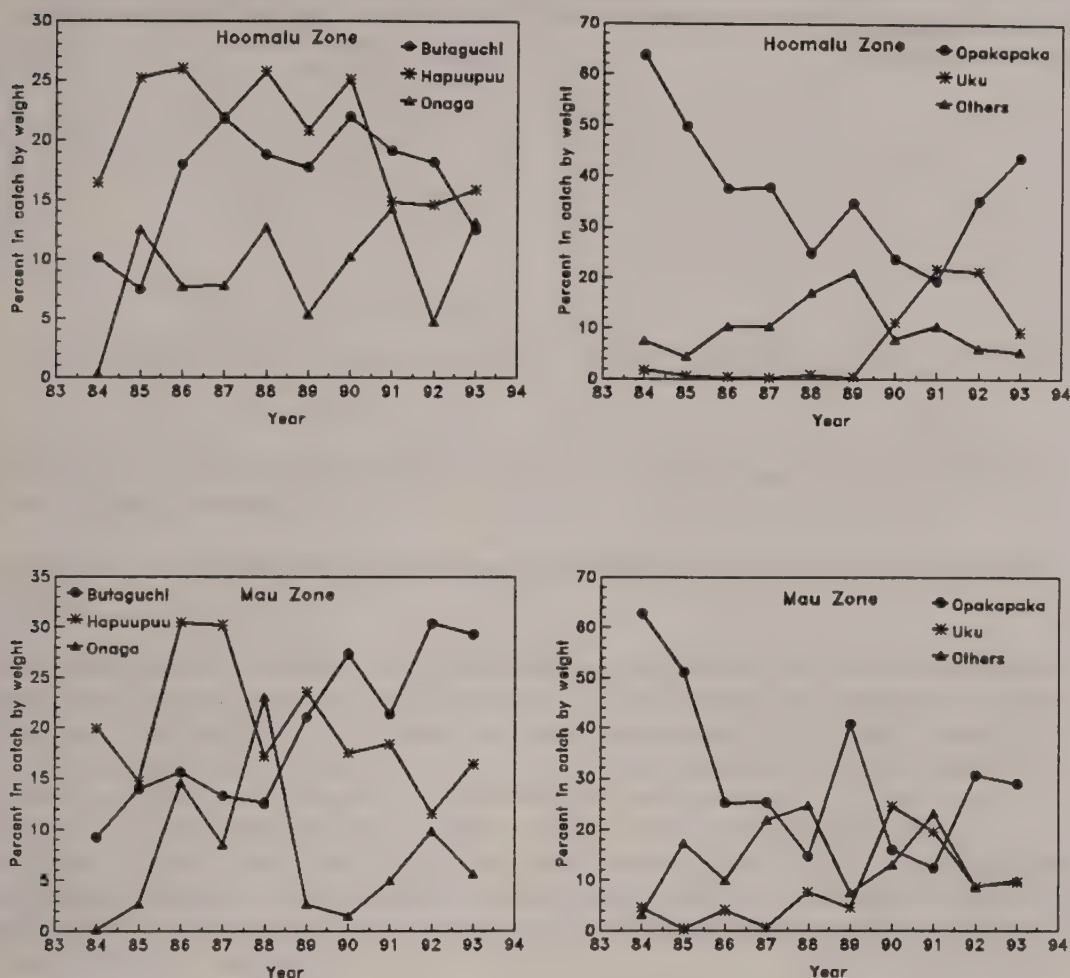
Figure 5 data summary:

Year	Boats		
	Mau	Hoomalu	Total ²
1984	NA	NA	19
1985	NA	NA	23
1986	NA	NA	24
1987	NA	NA	28
1988	4	12	13
1989	5	5	10
1990	14	5	16
1991 ¹	14	4	17
1992 ¹	8	5	13
1993 ¹	8	4	12

¹ Based on a combination NMFS and HDAR data set.

² Total may not match sum of areas due to vessel participation in multiple areas.

Figure 6. NWHI bottomfish catch composition



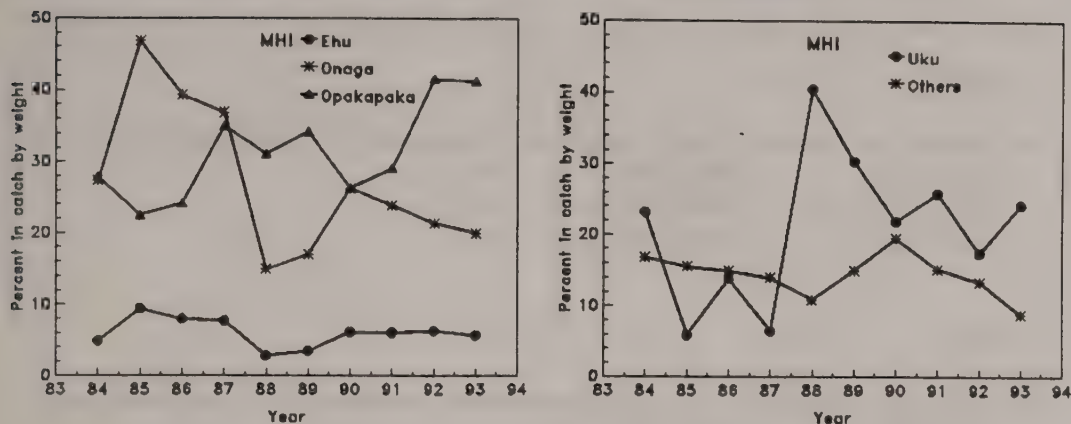
Source: Catch composition data collected at the Honolulu UFA auction by HDAR, NMFS and WPRFMC personnel, and the NMFS vessel interview program.

Calculation & Adjustment: Catch composition is expressed as percent of total bottomfish weight.

Comments: Hapuupuu increased slightly in the 1993 Mau Zone catch composition, while other species decreased (onaga) or remained relatively similar to previous years. Opakapaka and onaga increased in the 1993 Hoomalu Zone catch composition, while other species decreased (butaguchi and uku) or remained relatively similar to previous years.

Interpretation: Increases in the percentages of opakapaka and onaga in the 1993 Hoomalu Zone catch are due to uku catches returning to normal levels and vessels fishing farther up the chain in areas which have not been heavily fished recently where opakapaka and onaga are more abundant.

Figure 7. MHI bottomfish catch composition



Source: Catch composition data collected at the Honolulu UFA auction by HDAR, NMFS and WPRFMC personnel.

Calculation & Adjustment: Catch composition is expressed as percent of total bottomfish weight.

Statistical Analyses: Kendall's tau, Spearman's rho, and Kendall's W (overall concordance) tests were applied to the ranked data to test for consistency in the catch composition 1) over time, and 2) between areas, for the data presented here and on Fig. 2. Yearly blocks of species' rankings for each area were used in 1), and areal blocks of yearly rankings for each species were used in 2). To minimize the number of comparisons in 1), 3 year averages were used (4 for the time block of 1990-93). Table 1 shows the results of the tests; significance is designated at $p < 0.05$ by an asterisk following the K, S, or KW. Significance in the K and S tests indicate correlation between the pairs of ranks; significance in the KW test indicate concordance over all the ranks examined. The species referred to as ULT is pooled ulua, lehi, and taape.

Comments: The percentage of opakapaka in the MHI catch has remained high in 1993. Other species have remained relatively stable or declined slightly from 1992 levels, although uku has increased in 1993. Statistical analysis shows that species composition is generally consistent over time for each area, but there is little correlation between areas.

Interpretation: The high percentage of uku in the 1988 catch is due to an unusual abundance of this species in the MHI during that year. The low percentage of opakapaka for that year is a direct result of the high uku catches. Reasons for the variation in the catch composition of other species and years are not known at this time.

Table 1. Consistency in catch composition over time and between areas

MHI KW*

1984-1986	:	1987-1989	K*	S*
1987-1989	:	1990-1993	K*	S*
1984-1986	:	1990-1993	K*	S*

MAU KW*

1984-1986	:	1987-1989	K*	S*
1987-1989	:	1990-1993	K*	S*
1984-1986	:	1990-1993	K	S*

HOOMALU KW*

1984-1986	:	1987-1989	K*	S*
1987-1989	:	1990-1993	K*	S*
1984-1986	:	1990-1993	K*	S*

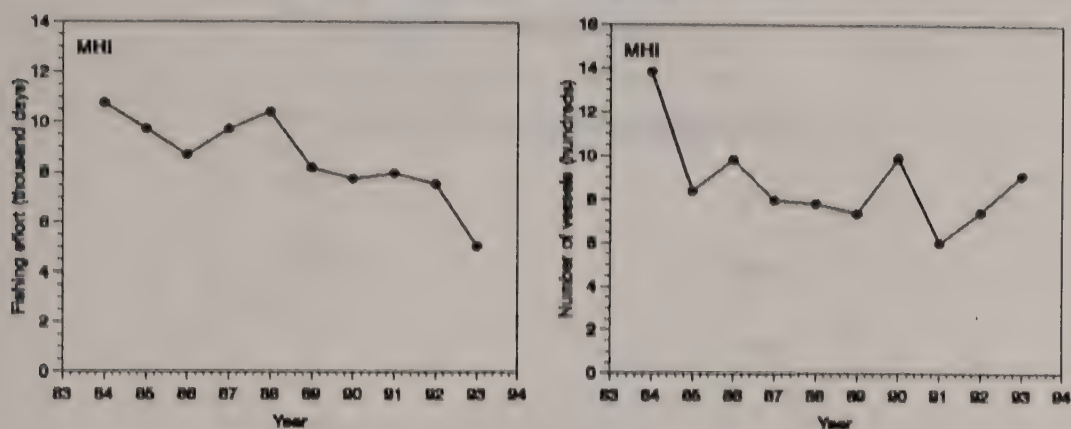
MHI : MAU

MAU : HOO

MHI : HOO

OPA	K	S	K*	S*	K	S	KW
ONA	K	S	K	S	K	S	KW
HAP	K	S	K	S	K	S	KW
BUT	K	S	K	S	K*	S*	KW
EHU	K	S	K	S	K	S	KW
KAL	K	S	K	S	K*	S*	KW
GIN	K	S	K	S	K	S	KW
UKU	K	S	K*	S*	K	S	KW*
ULT	K	S	K	S	K	S	KW

Figure 8. MHI bottomfishing trips & vessels



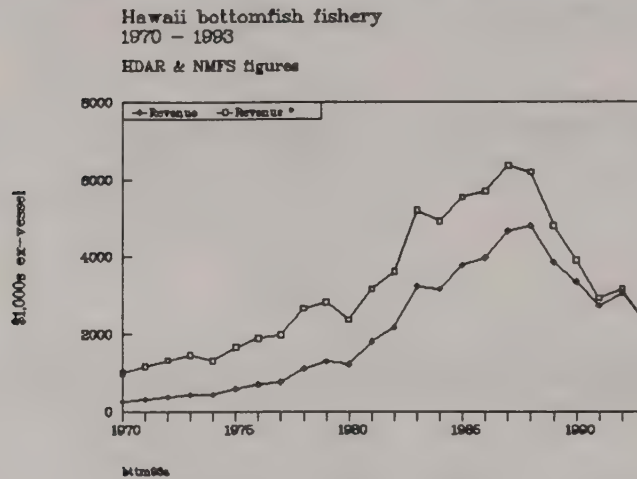
Year	Trips	Vessels
1984	10769	1386
1985	9747	841
1986	8682	985
1987	9719	797
1988	10415	785
1989	8190	739
1990	7764	992
1991	7991	601
1992	7574	742
1993	5069	914

Source: Fishing effort and vessels estimates are based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: MHI trips and vessels estimated from annual total MHI bottomfish landings, mean CPUE, and mean total landings per vessel. These estimates represent standardized units of Maui-Molokai-Lanai-Kahoolawe (MLMK) bottomfishing trips and vessels as applied to the entire MHI region. The MLMK criteria for MHI CPUE are described in Fig. 14-A. All values have changed slightly from previous year's reports due to modifications in the calculation. A preliminary expansion factor is used to estimate unreported recreational landings (from Hamm and Lum, 1992).

Interpretation: The reason for the continued decline in effort in the MHI is not known, however, it may be due to increased effort in pelagic fisheries.

Figure 9. Hawaii bottomfish landings revenue



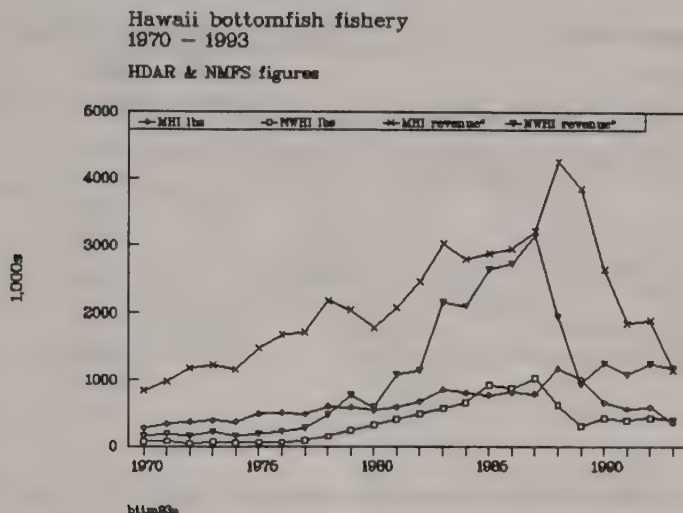
Source: Data are compiled from the NMFS shoreside monitoring program for the NWHI, and HDAR commercial catch reports.

Calculation & Adjustment: NWHI estimates for 1984-90 are compiled solely from NMFS shoreside monitoring. NWHI estimates for 1970-83 and 1991-93 are compiled from HDAR commercial catch reports, and a combination of NMFS and HDAR data, respectively. Prices are at the ex-vessel level.

Revenue adjusted for inflation (*) is calculated by multiplying each year's nominal (actual) revenue by the ratio of the 1993 Honolulu consumer price index (CPI) to each year's CPI. This adjusts early year revenues to the same purchasing power basis as 1993 revenue.

Interpretation: The time-series shows a dramatic decline since the late 1980s, with only a slight upturn in 1992. Both NWHI and MHI landings have declined over the same period.

Figure 10. Hawaii bottomfish landings and revenue by source

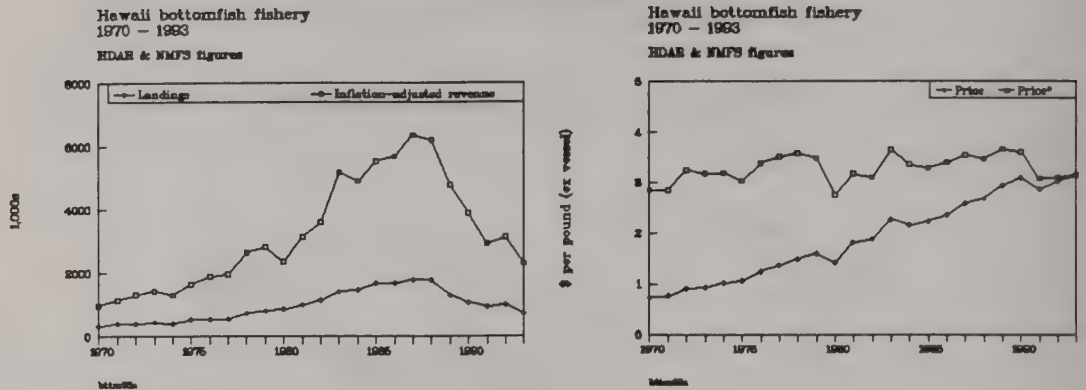


Source: NWHI landings and revenue data are collected by the NMFS shoreside monitoring program. MHI landings and revenue data are compiled from HDAR commercial catch reports.

Calculation & Adjustment: Revenue adjusted for inflation (*) is calculated by multiplying each year's nominal (actual) revenue by the ratio of the 1993 Honolulu consumer price index (CPI) to each year's CPI. This adjusts early year revenues to the same purchasing power basis as 1993 revenue.

Interpretation: Overall bottomfish landings and market dollar volume (adjusted for inflation) have continued to fall in 1993.

Figure 11. Hawaii bottomfish landings, revenue, and price



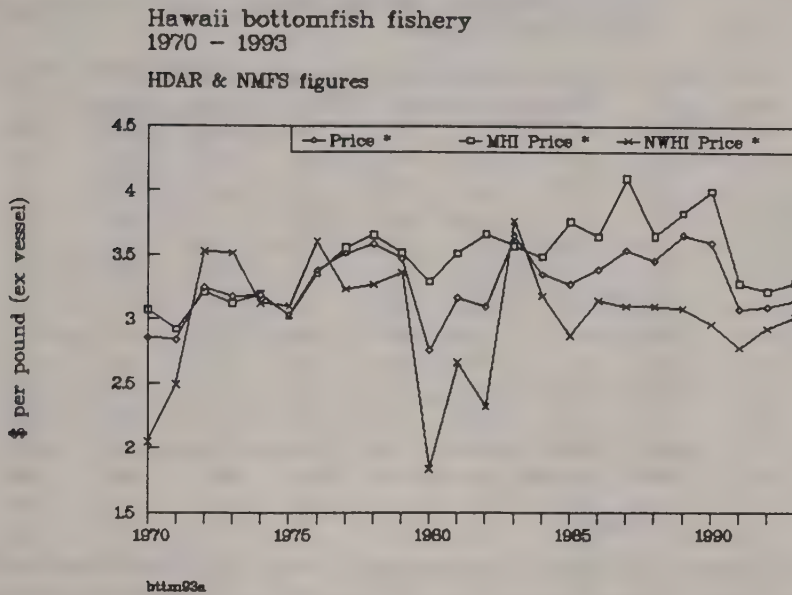
Source: Data are from the NMFS shoreside monitoring program for the NWHI, and HDAR commercial catch reports data tapes compiled by NMFS with the GAS (HDAR Gear-Area-Species summary compilation) computer programs.

Calculation & Adjustment: Revenue represents ex-vessel revenue, and is the overall average price for all bottomfish species combined.

Revenue and price (*) adjusted for inflation are calculated by multiplying each year's nominal (actual) value by the ratio of the 1993 Honolulu consumer price index (CPI) to each year's CPI. This adjusts early year dollar values to the same purchasing power basis as 1993 dollar values.

Interpretation: These values differ from previous reports in that combined NMFS/HDAR estimates of landings, revenue, and price are used. These figures show the growth of the domestic bottomfish fishery from the mid-1970s through the late-1980s, coincident with an increase in inflation-adjusted average price. The latter represents strong marketing of the bottomfish product, which also probably encouraged continued fishing pressure. Inflation-adjusted average price appears to be relatively stable in recent years; however, total revenue and landings continue to decline since the late 1980s.

Figure 12. Hawaii bottomfish average prices by source



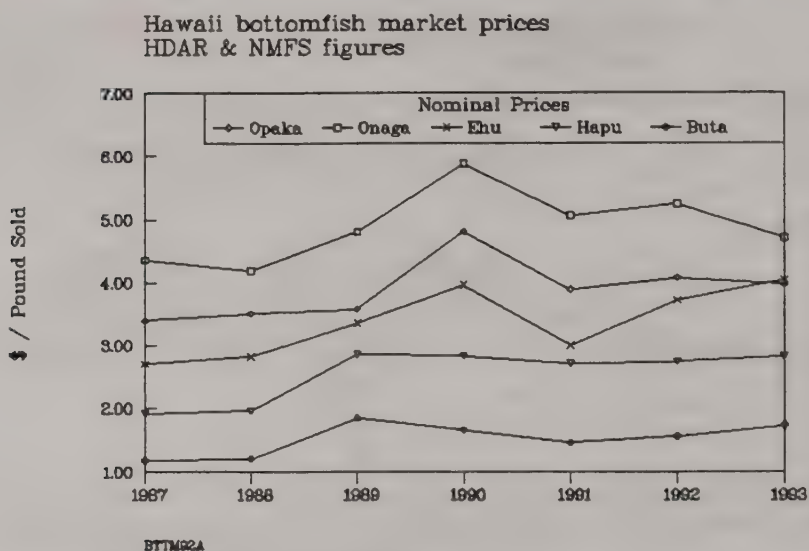
Source: Data are from NMFS monitoring of NWHI landings and HDAR commercial catch reports for NWHI and MHI landings. Import volume (pounds) is recorded by the NMFS Southwest Region's Market News program.

Calculation & Adjustment: Data from the MHI and NWHI sources and from imports were combined by NMFS into the average market category (labeled "Price" in Fig. 12). NWHI average prices are used to estimate import market dollar volume.

Inflation-adjusted revenue and prices (*) are constructed by multiplying each year's nominal (actual) revenue or average price by the ratio of the 1993 Honolulu consumer price index (CPI) to each year's CPI. This adjusts early year revenues and prices to the same purchasing power basis as 1993 revenue and average price.

Interpretation: Overall average prices for MHI landings are generally greater than NWHI landings. Inflation-adjusted prices have increased slightly in 1993.

Figure 13. Hawaii bottomfish average prices by species



Source: MHI data are from HDAR commercial catch reports. NWHI data are from NMFS shoreside monitoring. Import revenue data are compiled by the NMFS Southwest Region's Market News program from U.S. Food & Drug Administration monitoring of shipments into the Honolulu Customs District.

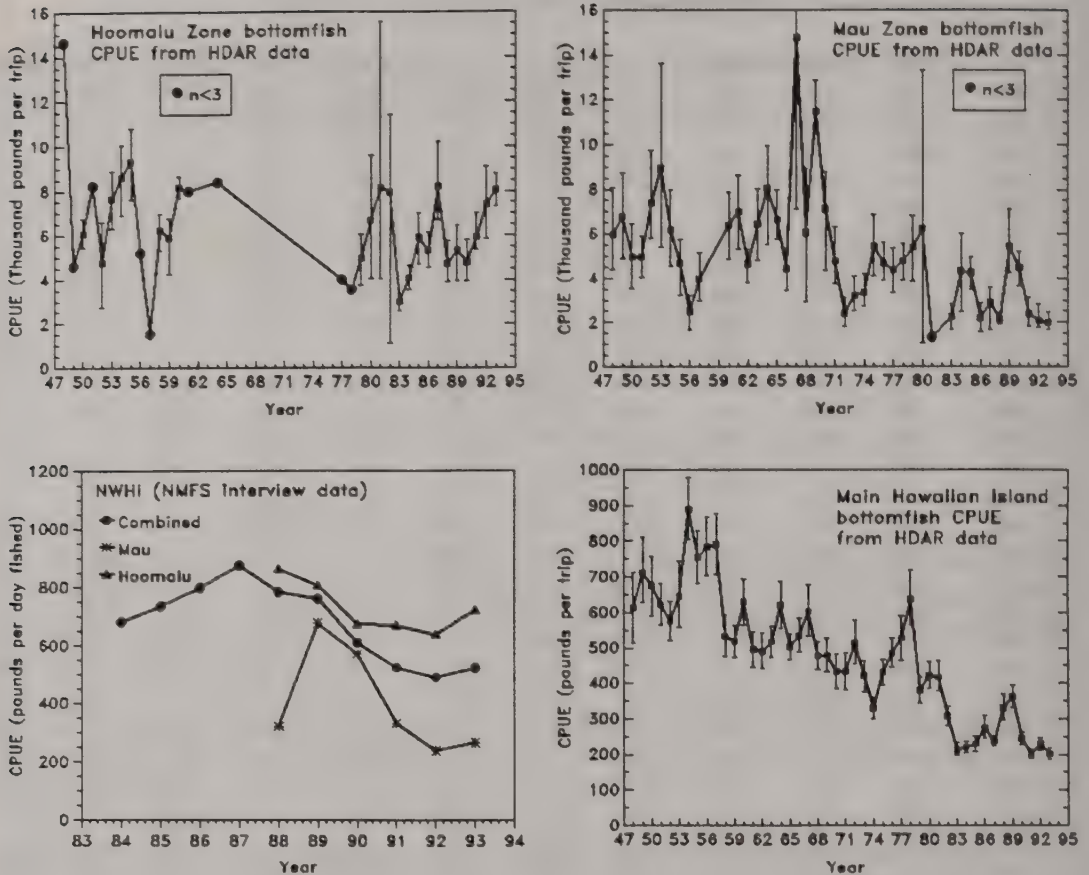
Calculation & Adjustment: Average price data are calculated by NMFS by combining MHI and NWHI estimates of landings and revenue. Import prices are NWHI overall average prices.

Interpretation: Prices for most bottomfish species remained relatively stable in 1993, although onaga prices have dropped and ehu prices have continued to increase slightly.

Table 2. Hawaii bottomfish data. Tabled values are 1000s of pounds landed, \$1000s ex-vessel, or \$/lb ex-vessel. An * denotes inflation-adjusted values. (Compiled from Pooley spreadsheet 5/25/94.)

Year	Total lb	MHI lb	NWHI lb	Total \$	Total \$*	MHI M\$*	NWHI N\$*	Total \$/lb	Total \$/lb*	MHI \$/lb*	NWHI \$/lb*
1948	1058	763	295	455	2846	2177	669	0.43	2.69	2.85	2.27
1949	1069	753	316	449	2857	2125	732	0.42	2.67	2.82	2.32
1950	905	550	355	304	2016	1412	603	0.34	2.23	2.57	1.70
1951	894	525	369	332	2074	1324	750	0.37	2.32	2.52	2.03
1952	1078	544	534	418	2536	1481	1056	0.39	2.35	2.72	1.98
1953	960	495	465	370	2227	1390	837	0.39	2.32	2.81	1.80
1954	707	424	283	267	1592	1139	453	0.38	2.25	2.69	1.60
1955	748	414	334	300	1765	1165	600	0.40	2.36	2.81	1.80
1956	648	512	136	292	1692	1417	276	0.45	2.61	2.77	2.03
1957	558	465	93	259	1454	1252	202	0.46	2.61	2.69	2.17
1958	525	462	63	240	1286	1179	107	0.46	2.45	2.55	1.70
1959	403	335	68	212	1117	980	137	0.53	2.77	2.92	2.01
1960	401	313	88	200	1025	843	182	0.50	2.56	2.69	2.07
1961	384	308	76	188	941	791	150	0.49	2.45	2.57	1.98
1962	439	374	65	220	1077	955	122	0.50	2.45	2.55	1.88
1963	534	442	92	253	1212	1049	163	0.47	2.27	2.37	1.77
1964	515	423	92	244	1165	1012	153	0.47	2.26	2.39	1.66
1965	405	354	51	213	999	914	84	0.53	2.47	2.58	1.65
1966	459	411	48	237	1080	998	82	0.52	2.35	2.43	1.71
1967	426	393	33	243	1078	1016	62	0.57	2.53	2.58	1.88
1968	638	605	33	265	1132	1073	60	0.42	1.77	1.77	1.81
1969	419	379	40	277	1132	1071	61	0.66	2.70	2.83	1.53
1970	344	270	74	253	983	831	151	0.73	2.85	3.07	2.05
1971	410	335	75	312	1164	977	187	0.76	2.84	2.92	2.49
1972	407	364	43	366	1322	1170	152	0.90	3.24	3.21	3.53
1973	454	392	62	418	1445	1227	218	0.92	3.18	3.13	3.51
1974	413	364	49	421	1316	1163	153	1.02	3.19	3.19	3.13
1975	544	485	59	577	1651	1468	183	1.06	3.03	3.03	3.10
1976	558	499	59	693	1888	1676	213	1.24	3.38	3.35	3.60
1977	562	479	83	764	1972	1704	269	1.36	3.51	3.56	3.24
1978	740	597	143	100	2650	2183	467	1.49	3.58	3.66	3.27
1979	809	580	229	1296	2810	2039	771	1.60	3.47	3.52	3.36
1980	856	541	316	1218	2363	1782	580	1.42	2.76	3.30	1.84
1981	993	591	402	1794	3147	2076	1072	1.81	3.17	3.51	2.67
1982	1162	673	488	2177	3602	2468	1133	1.87	3.10	3.67	2.32
1983	1422	847	575	3228	5189	3026	2164	2.27	3.65	3.57	3.77
1984	1464	803	661	3147	4901	2799	2103	2.15	3.35	3.49	3.18
1985	1687	765	922	3754	5525	2876	2649	2.23	3.27	3.76	2.87
1986	1680	811	869	3952	5688	2953	2734	2.35	3.39	3.64	3.15
1987	1799	784	1015	4645	6363	3212	3151	2.58	3.54	4.10	3.10
1988	1790	1165	625	4788	6191	4251	1939	2.67	3.46	3.65	3.10
1989	1310	1007	303	3840	4786	3851	935	2.93	3.65	3.83	3.08
1990	1082	661	421	3335	3889	2641	1248	3.08	3.60	4.00	2.96
1991	949	562	387	2713	2921	1844	1077	2.86	3.08	3.28	2.78
1992	1011	587	424	3052	3134	1891	1242	3.02	3.10	3.22	2.93
1993	734	348	386	2312	2312	1146	1166	3.15	3.15	3.29	3.02

Figure 14-A. CPUE for Hawaiian bottomfish



Source: MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen. Two NWHI CPUE's are presented, one based on the NMFS vessel interview program catch data, and one based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: MHI trips were screened to only include trips from the areas of Maui, Lanai, Molokai, and Penguin Banks that had at least 90% of the catch by weight in bottomfish. Additionally, some MHI small boats were excluded based on maximum annual landings criteria to correct for temporal changes in the fleet composition. The NMFS vessel interview data prior to 1988 does not allow separate Mau and Hoomalu CPUE calculations; therefore, the combined area NWHI CPUE is presented as well. The NWHI HDAR CPUE used data screened to only include trips where at least 90% of the catch by weight was bottomfish and at least 1000 pounds of bottomfish were caught. All catch data reported by the same licensee on consecutive days were collapsed to a trip summary, since 1) most other reports are apparent multi-day trip summaries, and 2) consecutive day reporting may be reflective of marketing rather than fishing activity. There was an apparent absence of

Hoomalu Zone trips from the mid-1960s until the late-1970s. The 95 % non-parametric confidence intervals for the HDAR CPUE's were calculated by bootstrapping.

Comments: There is a long-term decreasing trend in MHI CPUE, with current values approximately one-third that of initial. The 1993 MHI CPUE value is nearly the same as the 1992 value. MHI trips are generally one day in length, so CPUE values presented here reflect catch per day as well as catch per trip.

The NMFS vessel interview NWHI CPUE for 1993 has increased slightly over the 1992 value for the Mau Zone and increased substantially for the Hoomalu Zone. The Mau Zone HDAR CPUE values have, generally, been decreasing since 1989, which is consistent with the NMFS estimate. However, the Hoomalu Zone HDAR CPUE has been on an increasing trend since 1990, which is in contrast to the NMFS estimate where a decreasing trend was recorded from 1990-92, then an increase in 1993. The HDAR CPUE is used for NWHI SPR calculations since it is a longer time series and may better estimate virgin fishery catch rates. There are no correction factors for possible changes in trip duration or fleet composition.

Interpretation: Decreases in MHI CPUE to about one-third of early CPUE values signify a yellow light condition for the fishery in this area. The increase in the late 1980s MHI CPUE was due primarily to a large increase in uku catches alone and may not indicate an increase in abundance of other species. And decreases in CPUE from the 1989-90 highs may be a return to normal rather than a decrease in normal abundance. The reasons for differing trends in CPUE values for the Hoomalu Zone with differing data sources are unclear.

Figure 14-A data summaries:

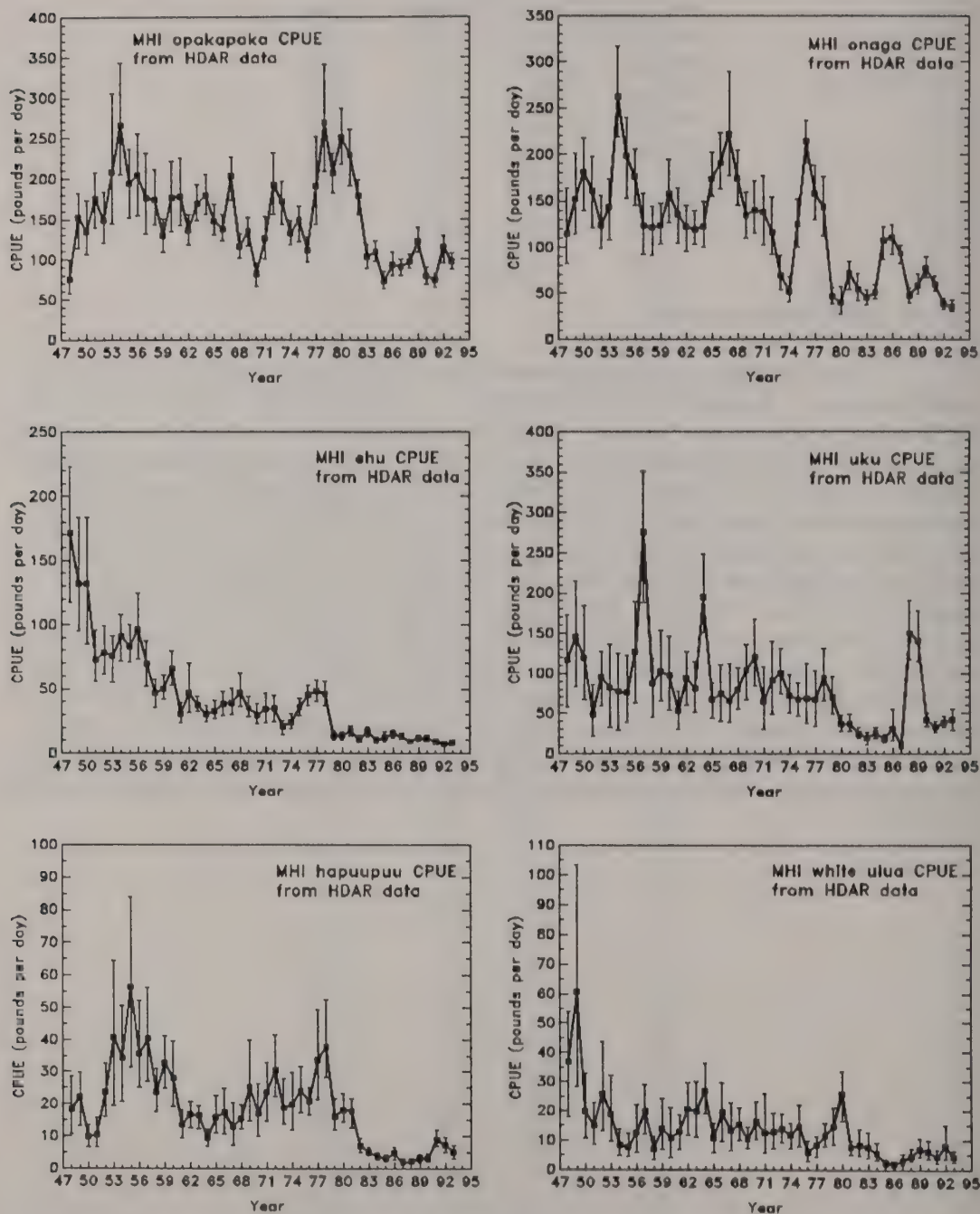
Year	Pounds/Trip		
	MHI	Mau	Hoomahu
1948	614	5968	14635
1949	713	6799	4614
1950	677	4966	6072
1951	621	4980	8228
1952	577	7407	4766
1953	645	8937	7627
1954	887	6158	8613
1955	755	4659	9336
1956	784	2523	5202
1957	789	3958	1535
1958	533	NA	6254
1959	519	NA	5897
1960	630	6379	8139
1961	496	6999	7978
1962	491	4641	NA
1963	518	6410	NA
1964	619	8028	8390
1965	503	6656	NA
1966	536	4413	NA
1967	602	14749	NA
1968	478	6055	NA
1969	480	11484	NA
1970	433	7111	NA
1971	433	4784	NA
1972	514	2386	NA
1973	421	3224	NA
1974	329	3367	NA
1975	430	5439	NA
1976	485	4653	NA
1977	527	4387	4000
1978	635	4753	3550
1979	380	5361	4951
1980	421	6210	6687
1981	416	1336	8167
1982	307	NA	7953
1983	214	2242	3025
1984	220	4308	4085
1985	230	4239	5909
1986	274	2206	5301
1987	237	2889	8187
1988	329	2136	4702
1989	361	5412	5328
1990	245	4454	4793
1991	202	2413	5928
1992	228	2092	7388
1993	202	1992	8040

Year	NMFS NWHI CPUE (lb/day)		
	Mau	Hoomalu	Combined
1984	NA	NA	682
1985	NA	NA	736
1986	NA	NA	800
1987	NA	NA	877
1988	322	866	786
1989	677	808	763
1990	573	675	611
1991	333	671	525
1992	239	639	491
1993	267	723	523

Note on confidence intervals:

There is extensive literature in which non-normality of CPUE error structure has been documented. In simple terms this means that, on occasion, there are some very large CPUE values which are not "balanced" with correspondingly small CPUE values; this leads to an asymmetric error structure which is not amenable to traditional, parametric confidence interval estimation. The bootstrapped intervals used here are also called non-parametric confidence intervals since there is no assumption of symmetrical error around the average value. If there is a large amount of high-end variability, then the confidence interval above the average value can be of greater span than the confidence interval below the average value, or vice-versa. Traditional methods would average the error and force an equal amount of uncertainty to either side of the average value. This is an unnecessary constraint and can lead to misinterpretation. If the error structure is symmetrical (i.e., normal), then the intervals derived from the non-parametric approach will mimic the intervals derived from the traditional approach. Alternative approaches such as log-transformation are available; however, such approaches assume a very particular type of asymmetrical error. In contrast, the bootstrap approach offers unconstrained flexibility in the type of error structure contained in the data.

Figure 14-B. Partial CPUE for MHI bottomfish



Source: The partial CPUE for the MHI is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The same subset of HDAR data as used in Fig. 14-A is used here, but the weight of each species is tabulated separately rather than in aggregate. The same denominator value used in Fig. 14-A is used here (# trips fished), i.e. summing these six partial CPUE's (and remaining BMUS CPUE's) will approximate the Fig. 14-A estimates. 95% non-parametric confidence intervals were calculated by bootstrapping.

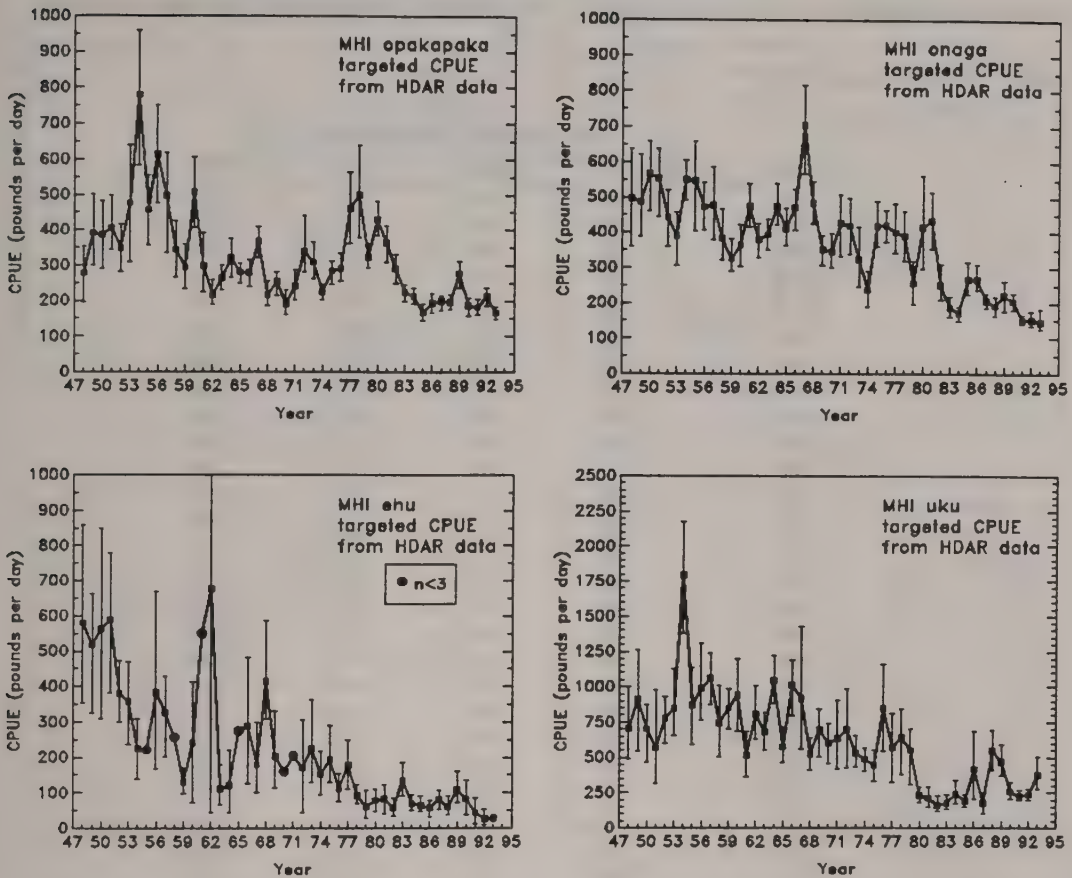
Comments: All CPUE time series remain highly variable. There are apparent declines in most species when comparing several years of recent values with values earlier in the time series. The decline is least apparent in opakapaka and most apparent in ehu. MHI trips are usually of one day duration.

Interpretation: Reduction of species-specific CPUE for species presented here to less than half of their early values would suggest a yellow light situation for these species, especially ehu and onaga. Caution must be used in this interpretation because factors such as targeting of effort to specific species is not taken into account (see next section for targeted effort).

Figure 14-B data summary

Year	MHI Partial CPUE (lb/trip)					
	OPA	ONA	EHU	UKU	HAP	ULU
1948	77	115	172	117	18	37
1949	153	153	132	146	22	61
1950	135	182	132	119	10	20
1951	176	161	73	48	11	15
1952	149	124	78	95	24	26
1953	208	144	76	82	41	19
1954	266	262	91	77	35	8
1955	195	198	83	76	56	8
1956	204	177	97	127	36	13
1957	176	124	70	275	40	20
1958	174	121	47	88	24	7
1959	130	124	50	103	33	14
1960	177	158	66	97	28	11
1961	178	136	31	54	13	13
1962	136	123	47	94	17	21
1963	169	120	38	82	16	20
1964	180	122	30	195	9	27
1965	148	174	33	67	16	11
1966	138	191	38	75	17	19
1967	203	222	39	66	13	13
1968	116	174	47	81	15	15
1969	135	135	35	104	25	10
1970	83	140	30	120	17	16
1971	127	138	34	65	24	12
1972	192	116	35	92	31	13
1973	171	70	21	101	19	14
1974	132	52	24	72	20	12
1975	149	124	36	68	24	15
1976	112	214	45	69	21	6
1977	191	158	49	67	34	8
1978	269	143	46	94	38	12
1979	207	47	13	70	16	15
1980	251	40	13	37	18	26
1981	229	72	18	37	18	8
1982	179	55	11	25	7	8
1983	104	46	17	20	5	8
1984	109	51	10	26	4	6
1985	74	107	12	18	3	3
1986	93	111	15	31	5	2
1987	91	93	13	10	2	3
1988	97	48	9	150	2	5
1989	122	59	12	140	3	7
1990	80	77	12	42	3	6
1991	75	60	9	34	9	4
1992	115	39	8	39	7	8
1993	97	35	8	42	5	4

Figure 14-C. Partial targeted CPUE for MHI bottomfish



Source: The partial targeted MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The data used in Fig. 14-A were further screened to only include trips where at least 50% of the total catch by weight is the target species. This can only be done for species that are targeted successfully; incidental catch species will not contribute significantly enough to the overall catch. 95% non-parametric confidence intervals were calculated by bootstrapping.

Comments: As in Fig. 14-B, there are apparent declines when comparing several recent years with values earlier in the time series. The decline is least apparent in opakapaka. The level of screening done here severely reduces the size of the sample, and this may contribute to some of the observed variability.

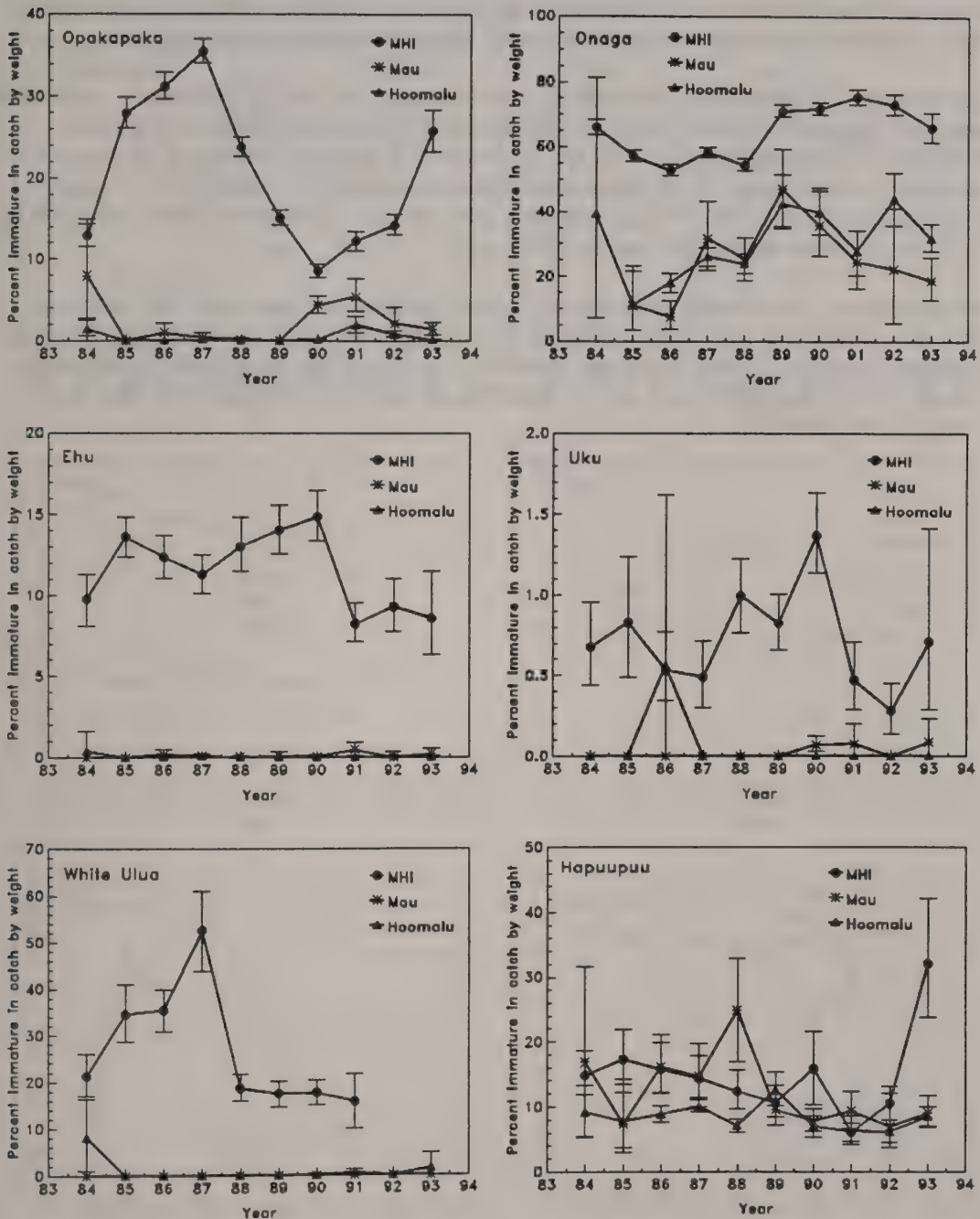
Interpretation: Comparison of CPUE values of the last 10 years (1984-93) with the first 10 years available (1948-57) indicate that all four species for which sufficient data is

available have CPUE values less than 50% of original values. Opakapaka CPUE values are at 43% of original, onaga at 40%, ehu at 15% and uku at 34%. These values represent a yellow light condition for these four species, with the ehu stocks being the most stressed.

Figure 14-C data summary:

Year	MHI Targeted CPUE (lb/Trip)			
	Opakapaka	Onaga	Ehu	Uku
1948	277	496	581	705
1949	391	488	517	913
1950	385	566	564	701
1951	406	554	589	567
1952	348	442	380	779
1953	476	390	358	850
1954	779	552	224	1796
1955	458	547	222	869
1956	613	473	384	988
1957	496	479	327	1061
1958	344	382	257	745
1959	293	325	130	852
1960	507	364	242	939
1961	297	476	550	514
1962	216	379	677	806
1963	263	394	111	683
1964	320	475	120	1046
1965	281	411	275	574
1966	280	472	288	1014
1967	366	706	180	919
1968	215	484	415	525
1969	254	353	203	696
1970	191	345	161	600
1971	241	428	205	634
1972	339	420	171	699
1973	309	324	226	531
1974	225	236	152	488
1975	284	419	194	448
1976	293	421	112	846
1977	462	400	178	573
1978	501	389	92	640
1979	323	255	61	552
1980	430	415	79	235
1981	364	433	83	212
1982	293	252	58	164
1983	225	186	135	179
1984	212	173	72	241
1985	168	266	63	193
1986	194	267	58	418
1987	199	206	82	175
1988	198	192	60	549
1989	278	221	109	468
1990	187	205	82	260
1991	183	153	45	224
1992	212	154	27	238
1993	167	146	28	375

Figure 15. Percent immature in Hawaiian bottomfish catch



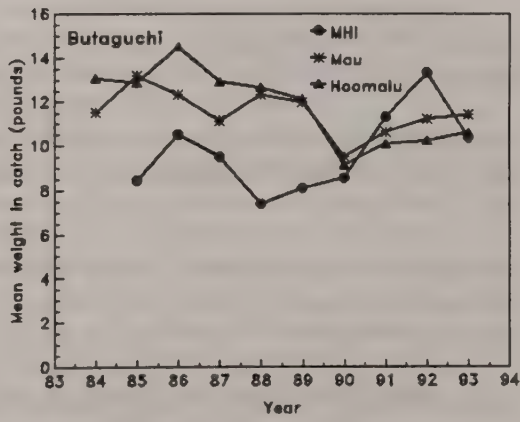
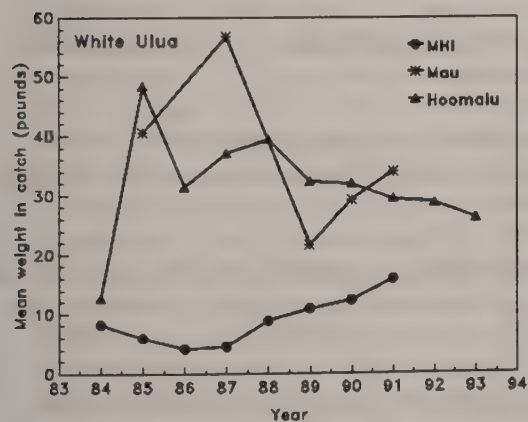
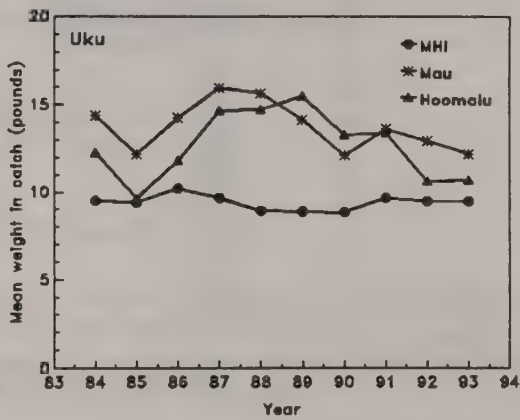
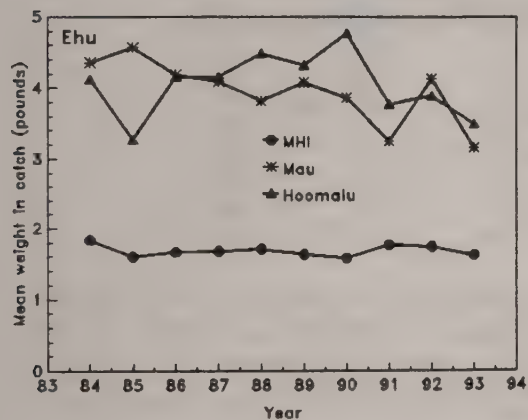
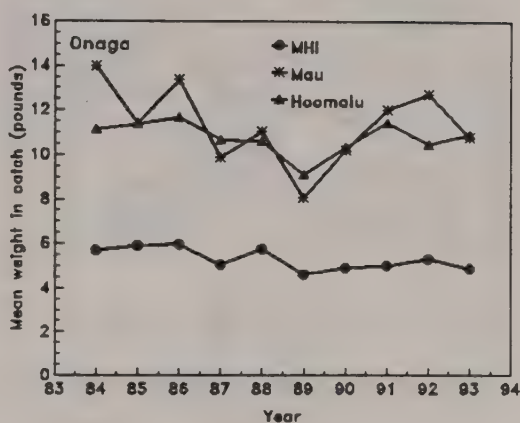
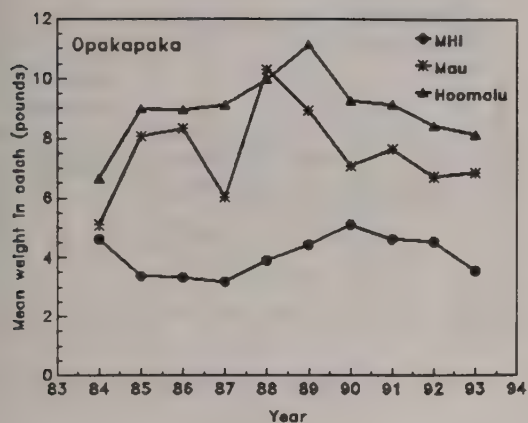
Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS and WPRFMC personnel. Size at maturity from Everson (1984), Everson (1990 unpub. rep.), Everson et al. (1989), Kikkawa (1984), Sudekum et al. (1991).

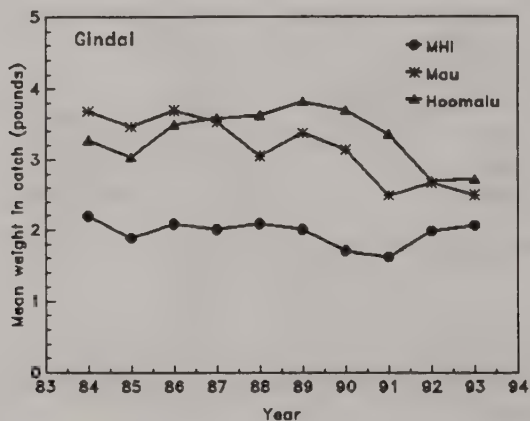
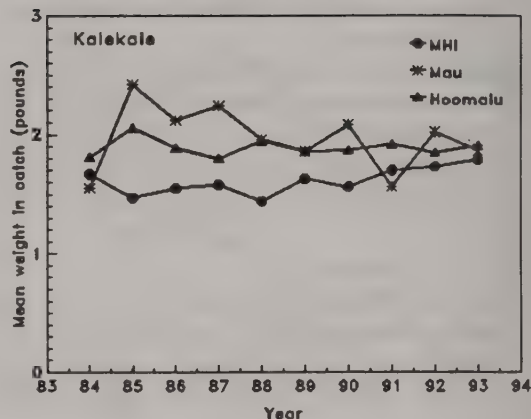
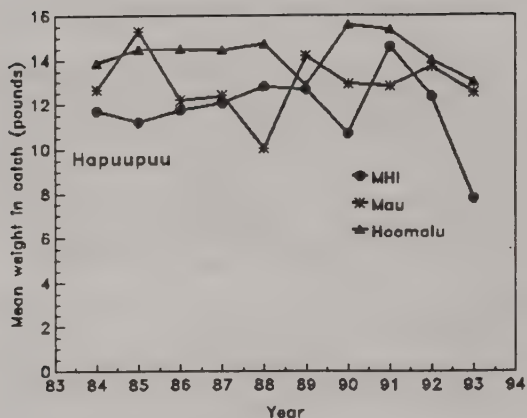
Calculation & Adjustment: The percent immature is calculated in terms of weight. The size distribution of sold fish is assumed to be representative of all fish caught. Maturity was assumed to be "knife-edge", and all fish in the same sales lot were assumed to be of equal size. 95% non-parametric confidence intervals were calculated by bootstrapping.

Comments: MHI catch is comprised of more immature fish than NWHI catch. In all areas onaga are among the highest values, though in recent years there appear to be gradual declines. Percent immature for uku are the lowest (i.e. healthiest) values in all zones. Among the other species, MHI opakapaka experienced periods of relatively high values (peaking in the years 1985-87), and has been increasing in recent years. MHI Hapuupuu in 1993 has increased markedly from the 1992 value.

Interpretation: MHI onaga catch has the highest percentage of immature fish, and is the only one consistently over 50%, signifying a yellow light condition. MHI hapuupuu values increased markedly in 1993, however, it should be noted that the sample size is very small (about 2.5% of the MHI catch) and the mean weight (see Fig. 16) though less than prior years, is not drastically so.

Figure 16. Mean weight of Hawaiian bottomfish





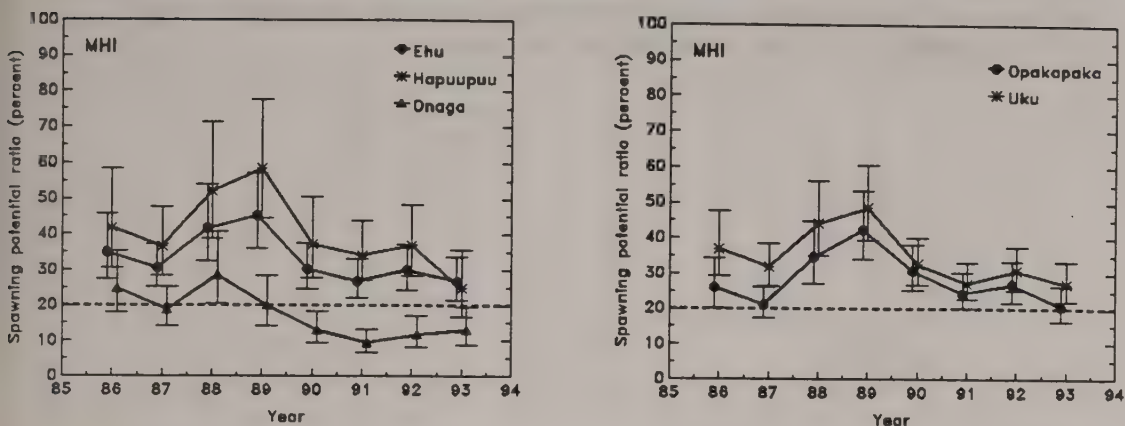
Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS, and WPRFMC personnel.

Calculation & Adjustment: The size distribution of sold fish is assumed to be representative of all fish caught. All fish in the same sales lot were assumed to be of equal size.

Comments: Mean weights of fish in the NWHI catch are generally larger than those in the MHI catch. Most 1993 values are similar to past values with no indication of continuously decreasing sizes.

Interpretation: The most notable change occurred in MHI hapuupuu; the cause for this decrease is unclear, yet it should be noted that the sample size for MHI hapuupuu is very small as this species only comprises approximately 2.5% by weight of the 1993 MHI bottomfish catches.

Figure 17. Spawning potential ratio (SPR) for MHI bottomfish



Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

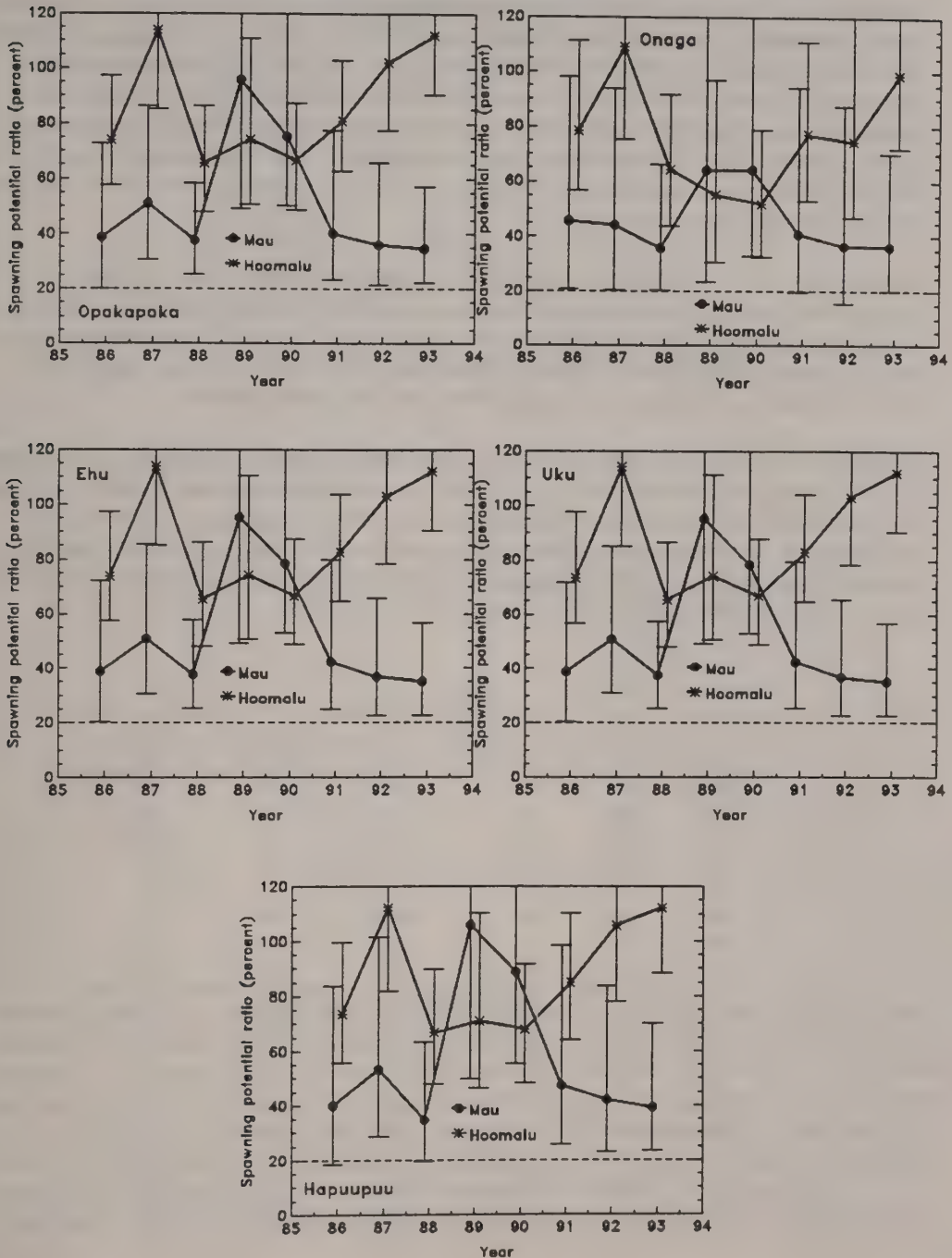
Calculation & Adjustment: Calculations use similar methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-1952 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish from the areas of Maui, Lanai, Molokai, and Penguin Banks (see Fig. 14-A for more details). Virgin catch size composition is estimated from the 1986-1988 NWHI catch data, and current catch size composition is estimated from single year MHI catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. The 95% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

Comments: Current SPR estimates for five of the six species are above the twenty percent critical level used as an indicator of recruitment overfishing. Onaga remains below 0.20. Ehu, hapuupuu, and uku SPR values remain consistently the highest.

Interpretation: The peak SPR values observed in 1988-1989 for all species were largely a response to increases in aggregate CPUE due to increased uku landings. Onaga SPR

values indicate a red light situation for this species. Values for other MHI species have not been below the 20% threshold, but have occasionally been close and the lower confidence limits have dipped below this level on occasion.

Figure 18. Spawning potential ratio (SPR) for NWHI bottomfish



Source: SPR estimated from Honolulu auction size frequency data collected by NMFS personnel, and CPUE estimates from C-3 form data reported to HDAR by commercial fishermen.

Calculation & Adjustment: Calculations use same methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-52 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish calculated separately for Mau and Hoomalu Zones. Virgin catch size composition is estimated from the 1986-88 NWHI catch data, and current catch size composition is estimated from single year catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. 95% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

Comments: Current SPR estimates for all six species in both zones are above the 0.20 critical level used as an indicator of recruitment overfishing though lower confidence limits often are near or slightly below this level. Mau Zone SPR estimates tend to be slightly lower than Hoomalu Zone SPR estimates for most species, and onaga SPR estimates tend to be slightly lower than those for most other species.

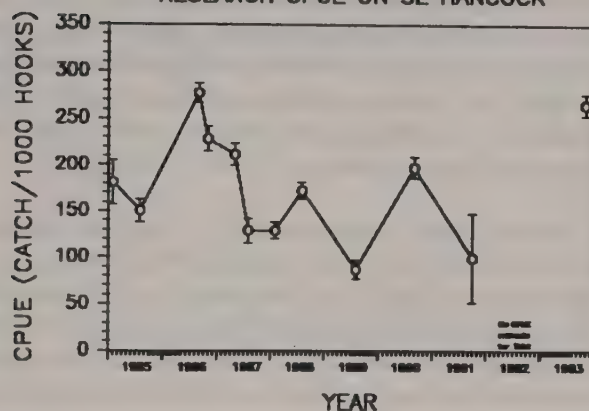
Interpretation: The correlation of SPR values among species is due the high dependence of SPR on the CPUE component, given that the maturity component is nearly negligible. All species utilize the same aggregate bottomfish CPUE component. The maturity component is small relative to MHI SPR calculations because 1) the NWHI catch is primarily mature fish, and 2) the current catch size composition is relatively unchanged from the best estimate of the virgin catch size composition.

SPR (%)					
Mau Zone					
Year	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	39	40	46	39	39
1987	51	53	44	51	51
1988	38	35	36	38	38
1989	95	106	64	96	95
1990	78	89	64	75	78
1991	42	47	41	40	42
1992	37	42	36	36	37
1993	35	39	36	35	35
Hoomalu Zone					
1986	74	74	78	74	74
1987	114	112	109	114	114
1988	66	67	65	66	66
1989	74	71	55	74	74
1990	67	68	52	67	67
1991	83	85	77	81	83
1992	103	106	75	102	103
1993	112	112	99	112	112

Figure 19. Armorhead stock assessment

(Note: no data for 1992)

RESEARCH CPUE ON SE HANCOCK



Month/Year	Aarmorhead CPUE
Jan 1985	181.28
Jun 1985	150.51
Aug 1986	276.80
Oct 1986	228.03
Apr 1987	210.98
Aug 1987	128.73
Jan 1988	128.77
Jul 1988	172.14
Jul 1989	86.69
Aug 1990	197.08
Sep 1991	98.97
1992	n/a
Oct 1993	264.85

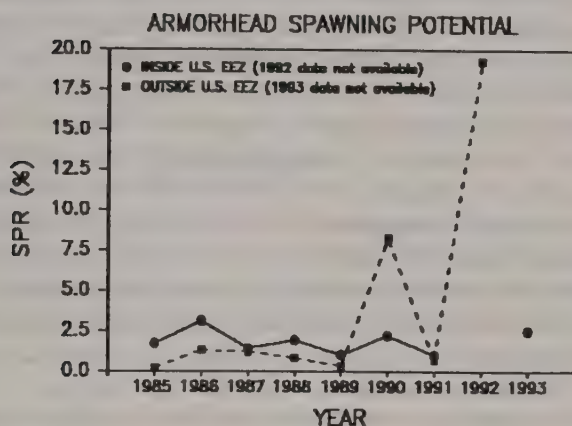
Source: Figure 19 presents CPUE based on research longline catches at SE Hancock Seamount by NMFS, Honolulu personnel aboard NOAA ship R/V Townsend Cromwell. Vertical bars represent the 95% confidence intervals about the mean CPUE. The CPUE derived from the September 1991 stock assessment survey was computed using data from only the first five bottom longline sets as opposed to the standard 40 sets used on all other research surveys. The armorhead population at SE Hancock Seamount was not assessed in 1992 and therefore no CPUE estimate is available. The latest stock assessment survey for armorhead at SE Hancock Seamount was conducted in October 1993.

Calculation & Adjustment: Fishing gear and sampling methods utilized during armorhead stock assessment surveys at SE Hancock Seamount are described in Somerton

and Kikkawa, 1992 (Fishery Bulletin, U.S., 90: 756-769). The seamount is divided into quadrants and effort is portioned equally among quadrants. Within each quadrant, effort is conducted over four depth strata (<265 m, 265-300 m, 301-400 m, and 401-500 m). CPUE is calculated as a depth stratified average. Based on gear comparison studies of fishing droppers with and without hook timers conducted on the August 1990 survey, new coefficients accounting for the negative effects of hook timers were computed and applied to the catches obtained on all SE Hancock research surveys since 1985. During the October 1993 assessment, hook timers were used exclusively.

Interpretation: The current (1993) research CPUE indicates a marked increase over the 1991 CPUE estimate and just below the highest CPUE (for August 1986) recorded since these surveys began back in 1985. The fluctuations in CPUE shown in Fig. 19 are apparently the result of episodic recruitment followed by high natural mortality. These peaks in CPUE correspond to years (1986 and 1990) where an appreciable proportion (at least one-third) of the armorhead population consisted of fat individuals (fatness index ≥ 0.26) considered new recruits to the seamount population. Fatness index is defined as body depth divided by fork length. Subsequent to recruitment individuals cease somatic growth and over the course of 3-4 years, survivors decline in fatness index and weight. Without subsequent recruitment to the population in succeeding years, the armorhead population as a whole would decline both in numbers (natural mortality) and in biomass (declining fatness index). The high 1993 CPUE is unusual, however, since fat individuals (new recruits) account for <15% of the 1993 population while leaner individuals (<0.23 in fatness index) form the bulk of the population. These results apparently indicate that the 1993 population is primarily derived from recruitment which occurred either in late 1991 or during 1992. Previous work indicates that little if any annual recruitment occurs after the summer months (Humphreys et al. 1993; Fishery Bulletin, U.S. 91:455-463) and the 1991 stock assessment survey coincided with the end of the summer season. This suggests that the increase in CPUE at SE Hancock for 1993 is most likely due to good recruitment during 1992. This would also imply that the biomass and therefore spawning potential ratio of the armorhead population at SE Hancock was higher in 1992 than in 1993.

Figure 20. Armorhead spawning potential ratio



Year	Armorhead SPR (%)	
	Inside US EEZ	Outside US EEZ
1985	1.7	0.2
1986	3.1	1.3
1987	1.4	1.2
1988	1.9	0.8
1989	1.0	0.3
1990	2.2	8.2
1991	1.0	0.7
1992	n/a	19.3
1993	2.5	n/a*

*see previous Interpretation Section

Source: SPR values for seamounts outside the U.S. EEZ are based on reported catch and effort data from the Japanese trawler fleet and values for seamounts within the U.S. EEZ (Hancock Seamounts) are based on research longline CPUE in addition to the trawl CPUE.

Calculation & Adjustment: SPR values outside the U.S. EEZ are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972). SPR values inside the U.S. EEZ are computed as the estimated biomass on SE Hancock Seamount divided by the 1970-1972 average biomass. Biomasses are estimated using procedures described in Somerton and Kikkawa (1992).

Interpretation: SPR within the region outside of the U.S. EEZ, which historically (Japan trawl fleet during the 1969-81 period) contributed 91% of the total catch of armorhead, is 19.3%; based on the most current (1992) available catch and effort

statistics from the Japanese North Pacific trawl fishery. This is the largest increase and highest SPR level attained outside of the U.S. EEZ in over a decade. The higher reported 1992 catches of armorhead were apparently achieved without the help of new fishing grounds or major changes in trawl gear or fishing strategy. This suggests that a very strong recruitment occurred at the northern seamounts in 1992 and this served as the basis for the high 1992 cumulative catch outside the U.S. EEZ. Based on current estimates of a 2-2.5 year pelagic phase prior to seamount recruitment, the 1992 recruitment would have originated from the 1989-1990 winter spawning season. If this is correct, then the large 1992 recruitment originated from a parental stock which in 1989 had the lowest SPR values both inside and outside the U.S. EEZ. This would appear to support the notion that dramatic increases in armorhead abundance across the seamounts are episodic and the product of environmental factors rather than simply a stock-recruitment relationship.

Previous plans to conduct a cooperative U.S.-Japan research trawl survey at the Hancock Seamounts immediately after the October 1993 NMFS survey were cancelled due to logistical problems. Instead, the Japan research trawl cruise surveyed only seamounts outside the U.S. EEZ during November 1993. Their cruise report indicates that very small catches were obtained at all seamounts outside the U.S. EEZ and that other trawlers contacted in the area were experiencing similar results. Furthermore, the bulk of the armorhead caught were "lean" in appearance suggesting little recruitment during 1993. Since this information may not necessarily reflect conditions experienced throughout all of 1993, conclusions remain tentative until the Japanese 1993 catch and effort data becomes available. With this caveat in mind, it would appear that a strong 1992 recruitment occurred at all seamounts and that this year class sustained the high catches throughout 1992. However, indications of low 1993 catch levels suggest that the increase in armorhead at seamounts outside the U.S. EEZ was short-lived and the stock has markedly declined. In light of the 1993 stock assessment results from SE Hancock and the fishing moratorium in effect there, the apparent change in abundance of armorhead outside the U.S. EEZ from 1992 to 1993 is probably attributable to both the effects of the sustained fishing effort and lack of subsequent recruitment in 1993.

Appendix 4

Northern Mariana Islands

Introduction

The NMI bottomfish fishery occurs primarily around the islands of Saipan, Tinian, Rota, Farallon de Mendilla, Anatahan and Aguigan, however, this discussion will be limited to the catches landed in Saipan which is by far the largest market. The fishery will be characterized by data collected through the Commercial Purchase Data Base which indirectly records actual landings by recording all local fish sales to commercial establishments. This data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Division of Fish and Wildlife (DFW) staff routinely collect and distribute invoice books to more than 60 participating local fish purchasers; which include practically all fish markets, stores, restaurants, hotels and roadside vendors ("fish-mobiles"). This data collection system was extended to Rota and Tinian in May 1993. Commercial Purchase data receipt forms for these two islands have been collected and are ready for computer entry, pending minor modification to the existing program to accommodate these two islands. Although this data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be comparable for most aspects of the fisheries. There were some corrections from last year's annual report and these 1992 data corrections are indicated in Figures 1, 2 and 3.

The NMI's bottomfish fishery consists primarily of small scale local boats engaged in commercial and subsistence fishing. Deepwater (>500 ft) fishing, targeting onaga and other prized snappers, is largely commercial, whereas, those targeting shallow water (100-500 ft) species, such as the emperors, can also be subsistence. It is assumed that hand lines, home fabricated hand reels or electric reels are the only gear utilized for the bottomfish fishery. Historically, some trips lasted more than one day, currently however, effort is defined and calculated on a daily trip basis. Fishing trips are generally restricted to daylight hours, with all vessels returning before or soon after sunset. The bottomfish fleet consists primarily of vessels less than 24 feet in length and are usually limited to a 20-mile radius from Saipan. The larger vessels are able to fish extended trips, sometimes traveling as far as Pagan. During 1993, more than 65% of the bottomfish were caught by these larger vessels.

Bottomfishing commands more skill than pelagic trolling and requires knowledge on the location of specific submerged bottom features and hooking techniques. Presently, bottomfish fishing can still be described as "hit or miss". Without fathometers and even nautical charts the majority of fisherman fish randomly, many times relying on land features for guidance to a fishing area. This type of fishing is very inefficient and usually results in a low CPUE when compared with pelagic trolling.

Summary

Bottomfishing in the NMI has somewhat stabilized from its previous decline, but it has not recovered nor has it shown any significant growth. This stabilization could become a "growth" in the fishery as evidenced by the overwhelming interest in the SPC/DFW bottom longline training project that was indicated in last year's report recommendation. Domestic US, joint-venture, and foreign vessels are still continuing their inquiry about full-time bottomfishing throughout much of the NMI. The impact to the commercial market is still unknown. During 1992, charterboat activities and their impact on the local fisheries market were being investigated. A system of collecting CPUE data (shallow bottom) for the charter boat catches had been implemented and were collected regularly.

The total number of bottomfishing operation and trips to islands north of Saipan, where bottomfish are more abundant, have increased (and is still increasing) over previous years.

Revenues and prices will most likely increase with renewed fishing interest despite the slight decrease that took place in 1992. Deepwater snappers still command the best prices. Fishermen utilizing larger vessels will have greater access to these fish; the market for them will improve as well, provided that supplies of these fish are consistent and fish quality is handled well. With a continual training program in bottomfishing that addresses proper fish handling, and the proper use of fathometers and nautical charts, this industry will certainly grow dramatically. In addition, training in electric reel repair, anchoring techniques and marketing should also be addressed.

With the planned expansion of biological data collection from the bottomfish fishery, an assessment can be completed for the bottomfish stocks surrounding Saipan. After identifying the extent of resource utilization, additional data collecting could be used to help determine management strategies.

Recommendations

- 1) The bottomfish training program should continue to be pursued.
- 2) A training/workshop should be conducted that concentrates on improving the local bottomfish market to both enhance and promote the industry. This training/workshop will provide local fishermen with better markets, and businesses with consistent and better bottomfish supplies.
- 3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deepwater bottomfish complex (e.g., survey on red-gilled emperor) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), to help calculate SPR, with assistance from NMFS.

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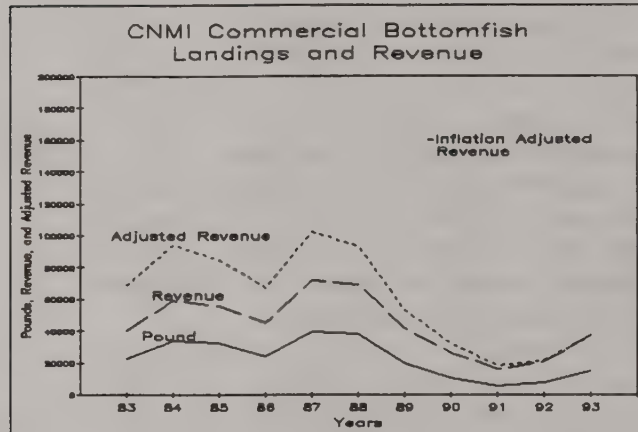
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Figure 1. NMI commercial bottomfish landings and revenue



Year	Pounds	Revenue	Adjusted Revenue
1983	22683	40003	68805
1984	33924	59005	93818
1985	32780	55396	84756
1986	23929	45079	67168
1987	39772	71868	102053
1988	37850	69052	93220
1989	19550	41379	52965
1990	10903	26323	32114
1991	5693	16118	18202
1992	8148	21032	21772
1993	14738	37241	37241

Calculation: Landings in pounds are from a simple data base summation of reported purchases of all bottomfish species combined. Revenue in dollars is from the same type of data base summation of the value field. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1993 CPI figure as the basis by which calculations of previous year's prices are made.

Interpretation: Landings, revenues and adjusted revenues for 1993 have increased over 1992. The increase is attributed to the increase in Bottomfishing operation (Fig. 3), particularly with new ventures that began operations in the last quarter of 1992 and the second quarter of 1993.

Table 1. NMI 1993 commercial landings of bottomfish species

Species	Pounds	Revenue	\$/lb
Bottomfish*	5644	15345	2.72
Jacks	363	923	2.54
Gindai	186	731	3.94
Grouper	917	2601	2.84
Onaga	474	2077	4.38
Opakapaka	718	2127	2.96
Emperor	6467	13506	2.09
Total	14769	37310	2.53

* denotes miscellaneous or non-identified species.

Calculation: Annual summaries for each species from invoice data sheets.

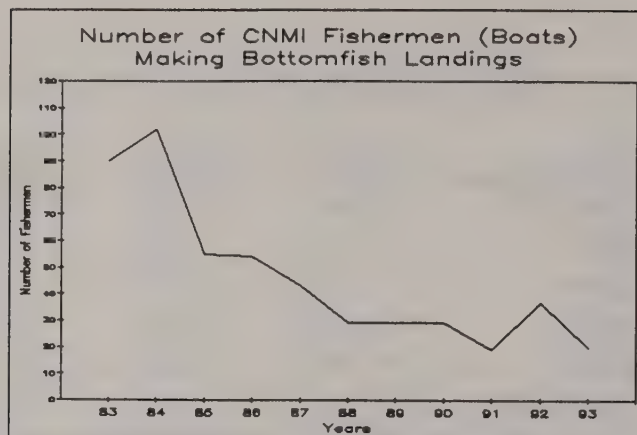
(Note: During 1993, the number of vendors increased along with the collection effort. There are about 20 participating local bottomfish fishermen (boats) compared to the approximate 38 that were recorded during 1992.)

Interpretation: Unfortunately, 38% of all 1993 bottomfish landings were not identified by species groups and any interpretations based on the above data would be questionable.

The deepwater bottomfish, onaga, commanded the higher prices per pound, while prices for shallower-water bottomfish (groupers and emperors) ranged from \$1.54 to \$2.29 per pound less.

The low average price per pound of \$2.53 is primarily due to the majority of bottomfish being sold at wholesale price to one specific vendor.

Figure 2. Number of NMI fishermen (boats) making bottomfish landings



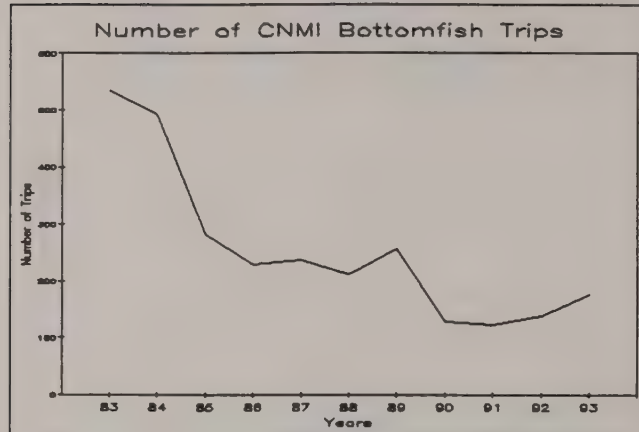
Year	Number of boats
1983	90
1984	102
1985	55
1986	54
1987	42
1988	29
1989	29
1990	29
1991	20
1992	37
1993	20

Calculation: The fisherman or boat selling the catch is identified on the "trip ticket" invoices used by purchasers. The plot shows the number of unique fishermen making any landings of bottomfish within a given year.

Interpretation: As with the number of trips (Fig. 3), the number of boats or fishermen making commercial landings of any bottomfish species declined from 1984 to 1988, stabilized between 1988-90, slightly increased during 1992 and then decreased again in 1993.

Although bottomfishing is showing a decrease in the number of boats selling the catch in 1993, the number of larger (50' plus) vessels (responsible for more than 65% of the catches) fishing regularly increased.

Figure 3. Number of NMI bottomfish trips

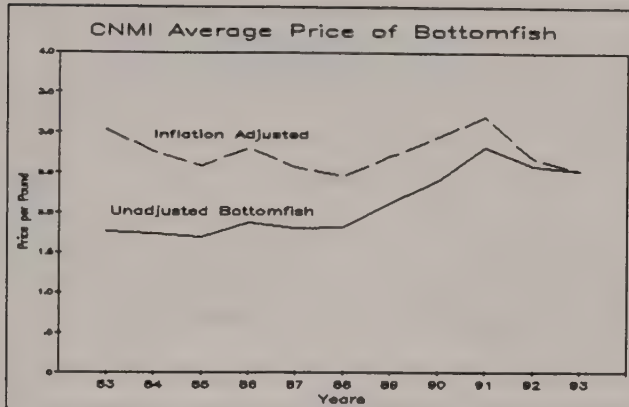


Year	Trips
1983	533
1984	492
1985	283
1986	229
1987	237
1988	211
1989	257
1990	129
1991	123
1992	138
1993	177

Calculation: The number of trips which resulted in landing any bottomfish are tallied by adding each recorded fisherman's trip on a given day. The assumptions are that each fisherman lands only once in a given day, and that he sells all of his catch on that day. Most trips are a single day length, but it is also known that longer fishing trips are increasing.

Interpretation: The increase that occurred in number of bottomfishing trips being taken by the NMI fleet is that there are now three vessels conducting frequently scheduled long trips to the northern islands, where bottomfish are more abundant.

Figure 4. NMI average price of bottomfish



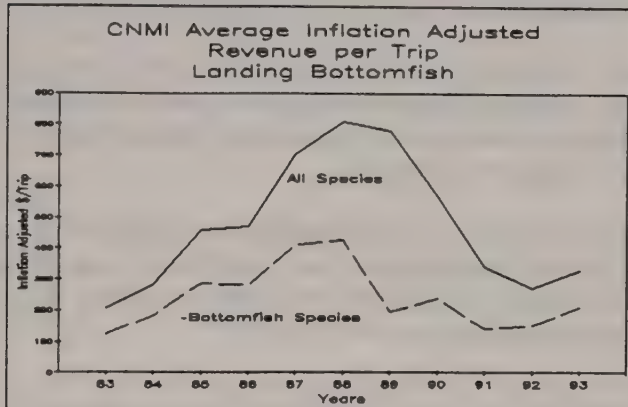
Year	Unadjusted \$/lb	Adjusted \$/lb
1983	1.76	3.03
1984	1.74	2.77
1985	1.69	2.59
1986	1.88	2.81
1987	1.81	2.57
1988	1.82	2.46
1989	2.12	2.71
1990	2.41	2.95
1991	2.83	3.20
1992	2.58	2.68
1993	2.53	2.53

Calculation: The average price of the bottomfish complex is calculated by dividing the total revenue by the total landings.

The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1993 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Interpretation: The average price increased steadily from 1988 to 1991, where it reached a record high of \$2.83. In 1993, the price dropped to \$2.53 due to the large volume of bottomfish being sold to a specific retail market establishment who then re-sold to other establishments at the customary prices. Re-sold catches are not included in this report.

Figure 5. NMI average inflation adjusted revenue per trip landing bottomfish



Year	Bottomfish species		All species	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	75	129	124	213
1984	120	191	186	296
1985	196	300	314	480
1986	197	294	330	492
1987	303	430	517	734
1988	327	441	621	838
1989	161	206	639	818
1990	204	249	485	592
1991	131	148	318	359
1992	152	158	272	283
1993	210	210	329	329

Calculation: Only trips which landed bottomfish are included in these calculations. "Bottomfish \$/Trip" is the total revenue of the bottomfish sold from a trip, and "All Species \$/Trip" is the total trip revenue of all species combined (e.g. any pelagic and reef fish which were sold).

The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1993 CPI figure as the basis by which calculations of previous years' prices are made. The

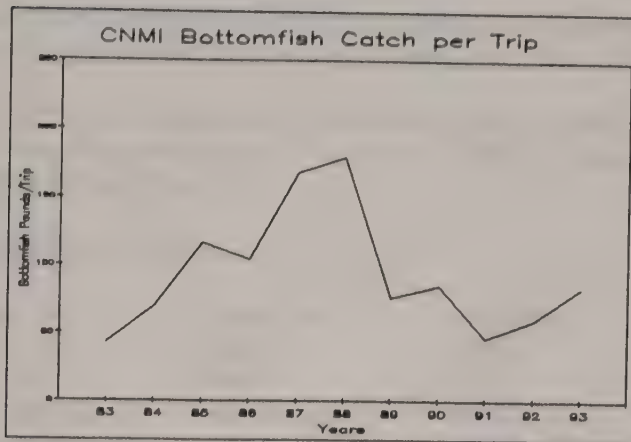
CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Interpretation: In general, inflation adjusted bottomfish revenue is making a slight increase in 1993, after experiencing a decline in 1991. The all species inflation adjusted revenue, which had been declining since 1988, has made a moderate increase in 1993.

The actual difference in price for inflation adjusted bottomfish revenue increased when compared with 1992. Inflation adjusted for all species revenue increased in 1993. Demand for bottomfish entering the market remained constant with previous year's, despite the increase of high price onaga and opakapaka.

Overall, bottomfish have increased in total landings from fishing trips until 1990 when that difference lessened. The bottomfish fishery has always been a small proportion of the total fisheries, but it appears that bottomfish are comprising a relatively higher percentage of the trip revenue on trips where bottomfish were caught.

Figure 6. NMI bottomfish catch in average pounds per trip



Year	Pounds per trip
1983	43
1984	69
1985	116
1986	104
1987	168
1988	179
1989	76
1990	85
1991	46
1992	59
1993	83

Calculation: The average catch per trip is calculated by dividing the total weight of all bottomfish landings by the number of trips which landed bottomfish, regardless of the amount of bottomfish landed on any given trip. Although the average catch per trip is not a very good measure of CPUE, because it is subject to significant biases (e.g. changes in trip length and relative amounts of bottomfishing compared to trolling), it is the only measure readily possible from the commercial landings system. It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish exclusively, but that has not yet been done. It is believed that the sample size resulting from this exercise would be extremely small and subject to other biases, however, it should be investigated in the future.

Interpretation: Even though bottomfish effort and landings are increasing slightly, the revenue obtained from bottomfish sales is relatively stable. This may be a function of the bottomfish fisherman trolling to and from the bottomfishing site, thus having a mixed catch after spending the day "bottomfishing".

Appendix 5. NMFS Administrative Activities

NWHI Limited Entry Program

During 1993, the NMFS Southwest Region issued a total of 35 fishing permits for the Northwestern Hawaiian Islands (NWHI) bottomfish fishery, the same number as in 1992.

In 1993, 30 vessels held Mau (qualifying) Zone permits, of which 19 were renewals and 11 were new entrants into the fishery. There were 11 vessels whose owners did not renew their Mau Zone permits from 1992.

Mau Zone (qualifying) vessels:

Aikane 49	Honua-Oe	Lei Alana
Alice I <i>(new)</i>	Imua	Liberty
Blue Sky	Iwalani	Lisa I
Boomerang <i>(new)</i>	J-Natsuko-O	Malia C <i>(new)</i>
Caroline L <i>(new)</i>	Jenine	Princess Mary <i>(new)</i>
Dai Ichi Maru <i>(new)</i>	Justin G <i>(former Mavis)</i>	Sang Won <i>(new)</i>
Dasher II	Kai Ola	Sea Eagle
Glory <i>(former Seungri Yi)</i>	Kasatka	Sea Hawk <i>(new)</i>
Goldstar	Kathleen <i>(new)</i>	Vostok <i>(new)</i>
Holokai	Lea Lea	White Knight <i>(new)</i>

Five vessels were issued Ho'omalulu (limited access) Zone permits in 1993, the same number as in 1992.

Ho'omalulu Zone (limited access) vessels:

Anna Riley - sank in April 1993
E.T.
Fortuna
Kaimi Kai
Laysan

As stipulated under Amendment 2 to the FMP, December 31, 1993 marked the end of the five-year grace period by which an application for an initial Ho'omalulu Zone permit must have been filed by any potential "grandfather" eligible to enter the NWHI bottomfish fishery. The Southwest Region received 10 applications for initial bottomfish limited access permits by the December deadline.

Appendix 6. NMFS 1993 Enforcement Activities

During 1993 NMFS agents accompanied six USCG C-130 patrols along the Northwestern Hawaiian Islands (NWHI).

There was only one possible illegal gear or fishing method in the NWHI. The subsequent investigation proved the allegation to be unfounded.

No violations of the reporting requirements have been documented.

The NMFS Law Enforcement Division has received only one complain, from the NWHI, and has not substantiated any violations of the Fishery Management Plan for Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region.

Appendix 7. Protected Species and Habitat

Protected Species

During calendar 1993, NMFS observers were placed aboard bottomfish vessels for 10 cruises. During this period the fleet consisted of 35 permitted vessels, of which 10 vessels were active at any one time. A total of 85 notifications were received for bottomfishing trips to the NWHI. Observer coverage for vessels fishing in the Mau Zone was 6 trips of 57, and for the Ho'omalulu Zone 4 trips of 28.

Interactions are defined as events during which fish or bait were stolen or damaged by marine mammals or sea birds, or when marine mammals, sea turtles or sea birds were hooked or entangled in gear. For the 10 trips, interactions with marine mammals were observed on 2 of 6 trips to the Mau Zone and 3 of 4 trips to the Ho'omalulu Zone. During a total of 605.9 hours of fishing effort during the 10 trips, 10 Hawaiian monk seal (*Monachus schauinslandi*) and 16 bottlenose dolphin (*Tursiops truncatus gilli*) interaction events occurred. This resulted in an observed interaction rate of one monk seal interaction for every 60.6 hours of fishing, and one bottlenose dolphin interaction for every 37.9 hours of fishing. These interactions may have involved one or more individual animals during each event. The combined rate for all marine mammal interactions was one event for every 23.3 hours of fishing effort. A total of 62 dolphins and 12 monk seals were involved in these interactions. There were no observed or reported injuries to or mortalities of Hawaiian monk seals or bottlenose dolphins as a result of these interactions. No interactions with sea turtles were observed. A few interactions with sea birds were reported but no injuries or mortalities occurred.

Flesh samples of kahala (*Seriola dumerili*) were collected to test for the presence of ciguatera in these fish from different areas in the NWHI. The samples are being analyzed by the NMFS Charleston Laboratory.

Protected Species Workshop: Twenty-nine bottomfish vessel operators completed the Protected Species Workshop required (as of June 2, 1993) to validate permits for the Ho'omalulu and Mau Zones in 1993.

Habitat Conditions and Recent Activities

Under the bottomfish FMP, regulations were implemented to prohibit the use of bottom trawls, bottom-set nets, explosives and poisons for harvesting bottomfish. This has served to greatly reduce the potential for bottomfish habitat degradation. To our knowledge, there have been no violations of these regulations in 1993.

As reported in earlier annual reports, there are several activities occurring, or reportedly occurring, in the EEZ that may potentially alter bottomfish habitat. These include:

1. Anchor damage by vessels attempting to maintain position over productive bottomfish habitat.
2. Habitat damage from heavy weights and line entanglements during normal hook-and-line bottomfish operations.

An activity which potentially may impact bottomfish habitat is a proposal to lease 26,910 square kilometers of the EEZ surrounding the Hawaiian Archipelago and Johnston Island for mining of cobalt rich manganese crusts. A joint State-Federal Task Force, which includes a staff member from the NMFS Habitat Conservation Program, has developed an environmental impact statement (EIS) for the proposed activity.

A permit modification for the Johnston Atoll Chemical Agent Disposal System (JACADS) was issued on September 8, 1993. The modifications will allow treatment of additional nerve agent munitions from western Europe and the Solomon Islands at the JACADS facility. A NMFS recommended monitoring program is in place.

A cooperative study designed and funded by EPA, NOAA, and the State of Hawaii Department of Health (DOH) was initiated in 1993 to determine cause and effect relationships between nutrient loading and coastal macroalgal blooms on West Maui. Results from these projects will be used to develop management plans for watersheds adjacent to West Maui coastal waters recently impacted by major blooms of at least two species of macroalgae.

The Hawaii Geothermal EIS Project was initiated with contract work ongoing to provide data needed to prepare the Federal EIS. NMFS is a cooperating agency in developing the document, primarily because of concerns about potential impacts from the interisland electrical transmitting cable system on marine biota and habitats. The Council will be kept apprised of the project as it progresses.

On October 14, 1993, the Taiwanese longline fishing vessel F/V *Jim Shiang Fa* ran aground on the reef along the western side of Rose Atoll, American Samoa. The vessel spilled an estimated 100,000 gallons of diesel fuel, 500 gallons of lube oil, and 2,500 pounds of ammonia. In November, NMFS participated in a multi-agency Natural Resource Damage Assessment of the atoll. Damage from spilled fuel products and physical damage from the vessel and gear was documented within the lagoon and on the outer atoll reef to a depth of 150 feet. Follow-up damage assessment will continue with reports submitted to the Council.

In 1993, the Marine Spill Response Corporation (MSRC) set up operations in Hawaii to respond to large oil spills in the Pacific islands. Their new top-of-the-line spill recovery vessel, the *Hawaiian Responder*, will be based in Honolulu Harbor. MSRC will handle spills greater than 1,250 bbls and the local Co-op, Clean Islands Council, with their smaller vessel will handle the smaller spills.

The potential threat to bottomfish habitat is reviewed through the Council's Ecosystems and Habitat Committee. The Council has adopted a Habitat Policy which will

assure that each fishery management plan includes all available information on habitat significant to the species being managed.

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